



# **SERVICE MANUAL**

**IC-V200**  
VHF FM TRANSCEIVER

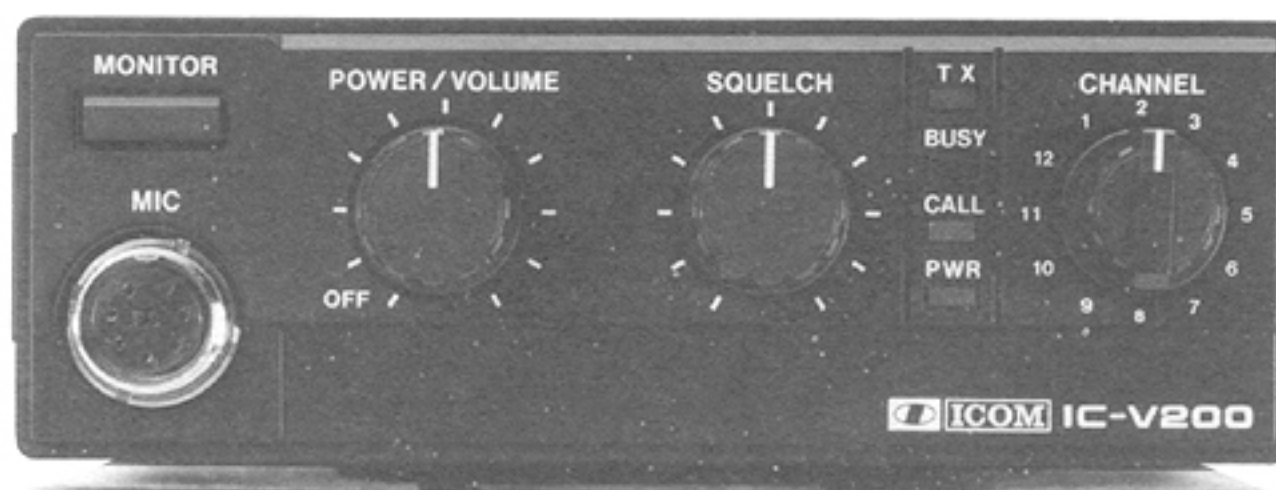
**ICOM INCORPORATED**



## SCOPE OF THE SERVICE MANUAL

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This service manual covers all service information related to the theoretical, physical, mechanical and electrical characteristics of the **IC-V200** VHF FM TRANSCEIVER.



## ASSISTANCE

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If you require assistance or further information regarding the operation, capability and servicing of the **IC-V200**, contact your nearest authorized ICOM Dealer or ICOM Service Center. Addresses are provided on the inside back cover for your convenience.

## ORDERING PARTS

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Be sure to include the following six points when ordering replacement parts or requesting equipment information from your dealer or ICOM Service Center. This will ensure faster, more efficient service.

1. Equipment model and serial number
2. Schematic part identifier or service manual page number
3. Unit name and printed circuit board number (e.g., PA UNIT/B-1234)
4. Component part number and name (e.g., 2SC1971 Transistor)
5. Quantity required (e.g., 5pcs.)
6. Order number (only for mechanical parts)

## REPAIR NOTE

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1. **DO NOT** open transceiver covers until the transceiver is disconnected from a power source.
2. **DO NOT** connect the transceiver to an external power source of more than 16V.
3. **DO NOT** force any of the variable components. Turn them slowly and smoothly.
4. **DO NOT** short any circuits or electronic parts.
5. An insulated tuning tool **MUST BE** used for all adjustments.
6. **DO NOT** keep power ON for a long time when the transceiver is defective.
7. **DO NOT** transmit power into a signal generator or sweep generator. Always connect a 30dB~40dB attenuator between the transceiver and a deviation meter or spectrum analyzer when using such test equipment.
8. Read the instructions of test equipment thoroughly before connecting equipment to the transceiver.

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# SECTION 1 SPECIFICATIONS

## ■ GENERAL

Frequency range	:	<table><tr><th>VERSION</th><th>COVERAGE (MHz)</th></tr><tr><td>GENERAL (#01)</td><td>146 ~ 174</td></tr><tr><td>GENERAL (#02)</td><td>146 ~ 174</td></tr><tr><td>USA (#03)</td><td>148 ~ 160</td></tr><tr><td>USA (#04)</td><td>156 ~ 168</td></tr><tr><td>USA (#05)</td><td>164 ~ 174</td></tr><tr><td>U.K. (#06)</td><td>146 ~ 174</td></tr></table>	VERSION	COVERAGE (MHz)	GENERAL (#01)	146 ~ 174	GENERAL (#02)	146 ~ 174	USA (#03)	148 ~ 160	USA (#04)	156 ~ 168	USA (#05)	164 ~ 174	U.K. (#06)	146 ~ 174
VERSION	COVERAGE (MHz)															
GENERAL (#01)	146 ~ 174															
GENERAL (#02)	146 ~ 174															
USA (#03)	148 ~ 160															
USA (#04)	156 ~ 168															
USA (#05)	164 ~ 174															
U.K. (#06)	146 ~ 174															
Number of channels	:	12														
Usable temperature range	:	-30°C ~ +60°C														
Channel spacing	:	<table><tr><th>VERSION</th><th>CHANNEL SPACING (kHz)</th></tr><tr><td>GENERAL (#01)</td><td>12.5</td></tr><tr><td>GENERAL (#02)</td><td>25</td></tr><tr><td>USA (#03)</td><td>25</td></tr><tr><td>USA (#04)</td><td>25</td></tr><tr><td>USA (#05)</td><td>25</td></tr><tr><td>U.K. (#06)</td><td>12.5</td></tr></table>	VERSION	CHANNEL SPACING (kHz)	GENERAL (#01)	12.5	GENERAL (#02)	25	USA (#03)	25	USA (#04)	25	USA (#05)	25	U.K. (#06)	12.5
VERSION	CHANNEL SPACING (kHz)															
GENERAL (#01)	12.5															
GENERAL (#02)	25															
USA (#03)	25															
USA (#04)	25															
USA (#05)	25															
U.K. (#06)	12.5															
Antenna impedance	:	50Ω														
Power supply requirement	:	13.8V DC (Negative ground)														
Current drain	:	Receive standby 350mA Receive max. audio 1.0A Transmit 3.0A (#01, #02, #06) 6.0A (#03, #04, #05)														
Dimensions	:	140(W) × 50(H) × 163(D)mm (Projections not included)														
Weight	:	1.3kg														

## ■ RECEIVER

Receiving system	:	Double-conversion superheterodyne
Modulation acceptance	:	±7kHz (#03, #04, #05)
Intermediate frequency	:	1st: 21.8MHz                      2nd: 455kHz
Sensitivity	:	0.35μV for 12dB SINAD
Threshold squelch sensitivity	:	0.18μV
Spurious and image rejection	:	70dB
Selectivity	:	70dB at adjacent channel
Intermodulation rejection	:	70dB
Audio output power	:	More than 3W at 10% distortion with a 4Ω load
Audio output impedance	:	4Ω
Frequency stability	:	0.0005%



## ■ TRANSMITTER

RF output power

VERSION	RF OUTPUT POWER (W)
GENERAL (#01)	10
GENERAL (#02)	10
USA (#03)	25
USA (#04)	25
USA (#05)	25
U.K. (#06)	10

Emission mode

: 16K0F3E

Modulation system

: Variable reactance frequency modulation

Max. frequency deviation

VERSION	MAXIMUM DEVIATION (kHz)
GENERAL (#01)	±2.5
GENERAL (#02)	±5
USA (#03)	±5
USA (#04)	±5
USA (#05)	±5
U.K. (#06)	±2.5

Spurious and harmonic emissions : 70dB below peak output power

Frequency tolerance : 0.0005%

Adjacent channel power : 70dB

Audio frequency response : -3dB ~ +1dB in a 6dB/octave range from 300Hz to 3000Hz

Audio harmonic distortion : 10% maximum

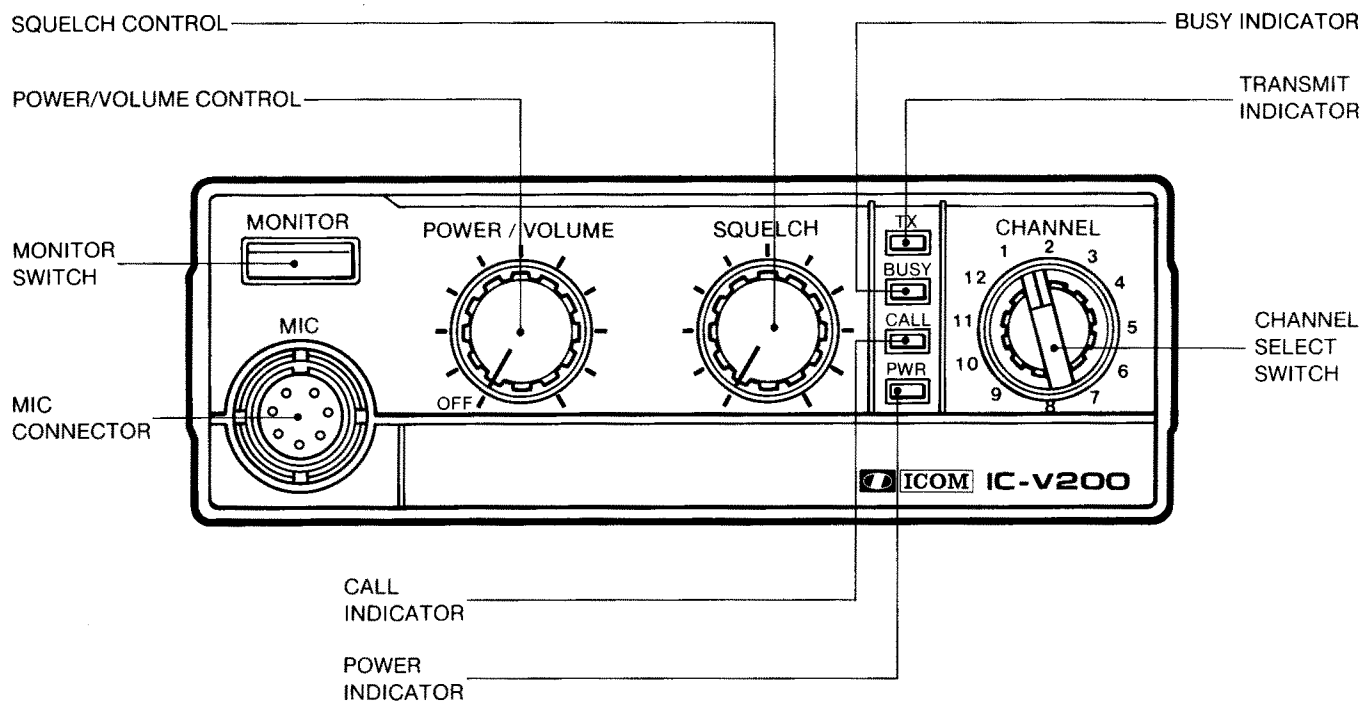
Hum and Noise : 40dB

Limiting of modulator : 70 ~ 100% of maximum deviation

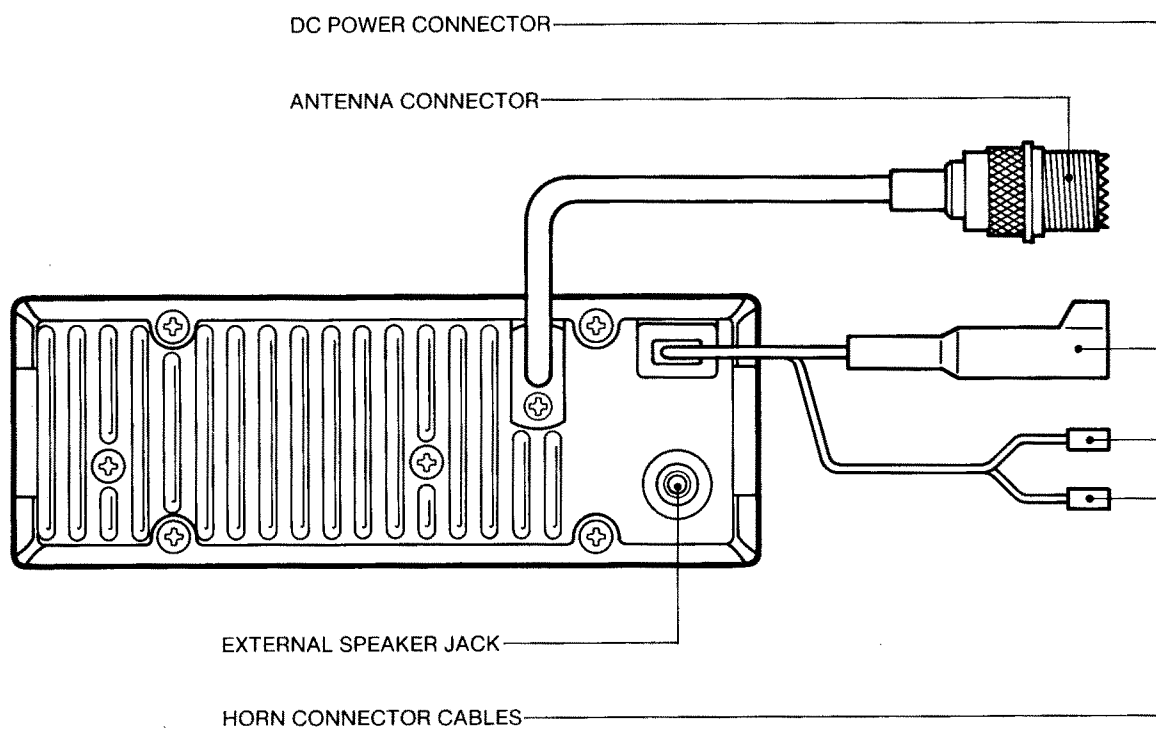


## SECTION 2 OUTSIDE AND INSIDE VIEWS

### 2-1 FRONT PANEL

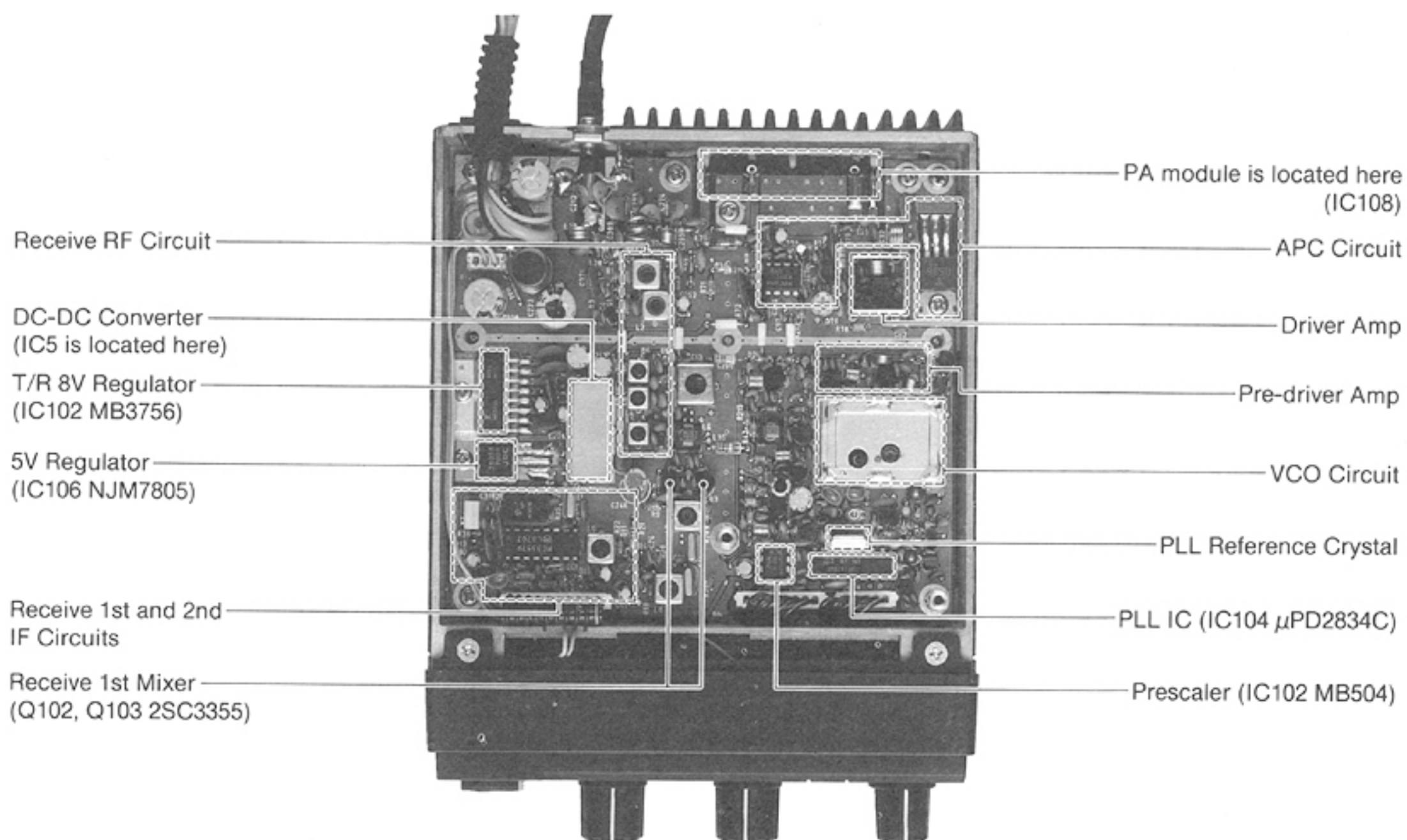


### 2-2 REAR PANEL

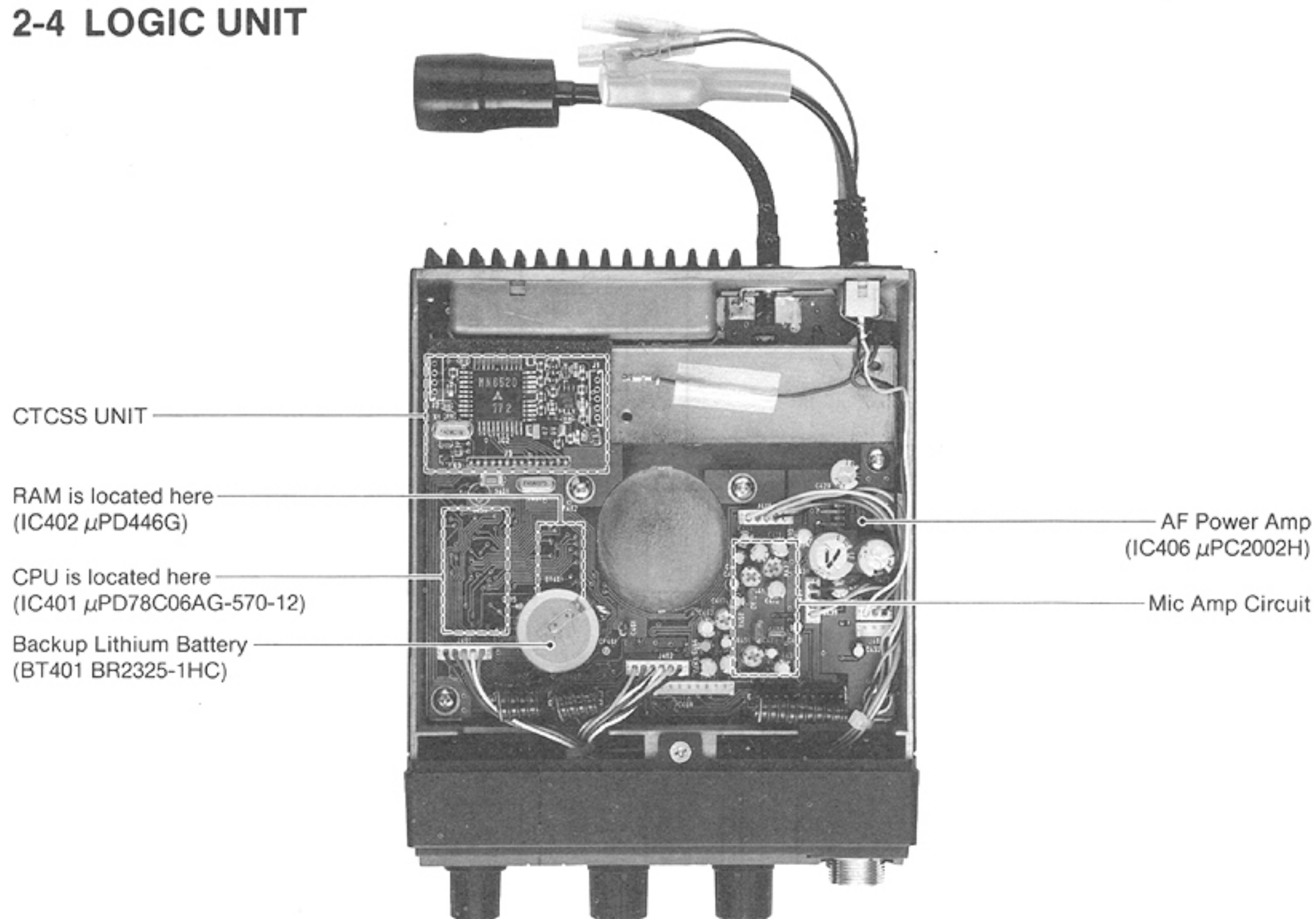




## 2-3 MAIN UNIT

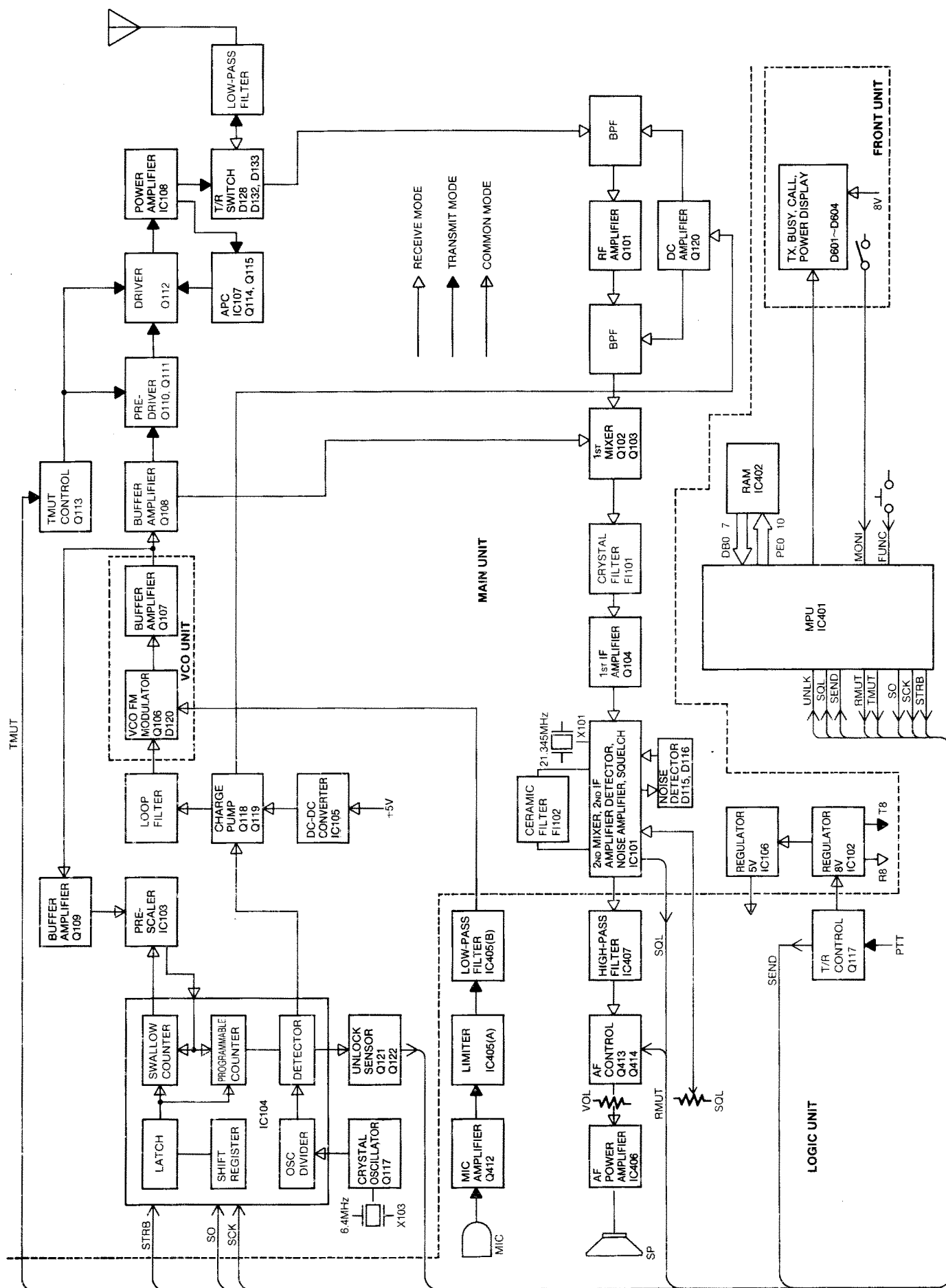


## 2-4 LOGIC UNIT





# SECTION 3 BLOCK DIAGRAM





## SECTION 4 CIRCUIT DESCRIPTION

### 4-1 RECEIVER CIRCUITS

#### 4-1-1 ANTENNA SWITCHING CIRCUIT (MAIN UNIT)

Receive signals enter the MAIN UNIT from the ANTENNA CONNECTOR and pass through a low-pass filter consisting of L127~L129 and 8 capacitors. They then are fed to an antenna switching circuit consisting of D128, D132, D133 and other parts.

#### 4-1-2 RF CIRCUIT (MAIN UNIT)

Signals from the antenna switching circuit pass through a 2-stage bandpass filter consisting of D101~D104, L101, L102 and other parts, and are amplified at Q101. Signals then pass through a 3-stage bandpass filter consisting of D105~D110, L103~L105 and other parts. They are then fed to the 1st mixer circuit which consists of Q102, Q103, L106, L107 and other parts for conversion to 21.8MHz 1st IF signals. Local oscillator signals are generated at VCO circuit Q106, are buffer amplified at Q107 and Q108, and are fed to L106.

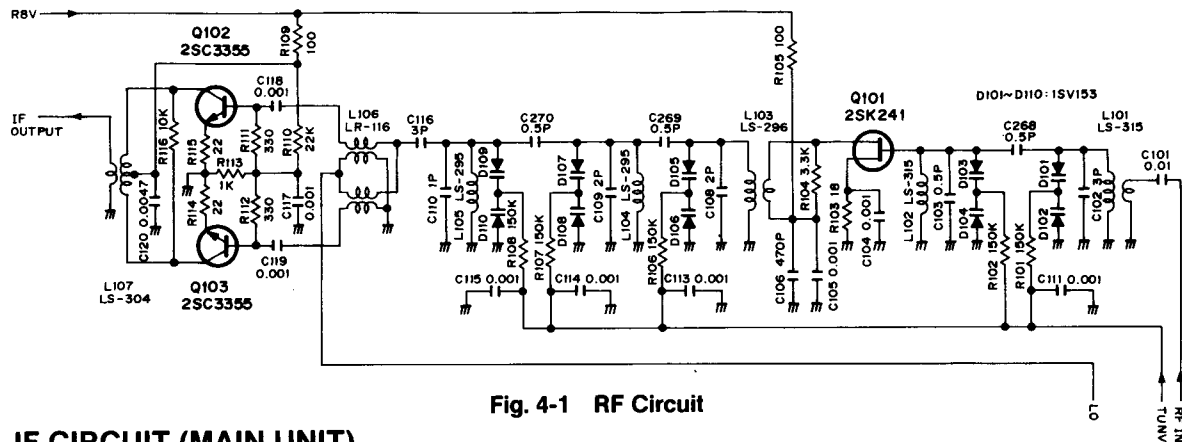


Fig. 4-1 RF Circuit

#### 4-1-3 IF CIRCUIT (MAIN UNIT)

1st IF signals from L108 pass through a pair of crystal filters (F1101) to suppress out-of-band signals and unwanted heterodyned frequency signals. After passing through the filter, the 1st IF signals are amplified at IF amplifier Q104, and fed to IC101.

IC101 contains the 2nd LO circuit, 2nd mixer circuit, limiter amplifier circuit, squelch trigger circuit and quadrature detector circuit. The 2nd LO circuit, which includes X101, generates 21.345MHz 2nd LO signals which are used at the 2nd mixer section of IC101.

1st IF signals from Q103 are fed to pin 16 of IC101, and are mixed with 2nd LO signals for converting the 1st IF signals to 455kHz 2nd IF signals.

The 2nd IF signals are output from pin 3 and pass through high-quality ceramic filter F1102 to suppress unwanted heterodyned frequency signals. They are then amplified at the limiter amplifier section (pin 5 of IC101) and applied to a quadrature detector circuit (pin 8 of IC101 and ceramic resonator X102) to demodulate 2nd IF signals to AF signals.

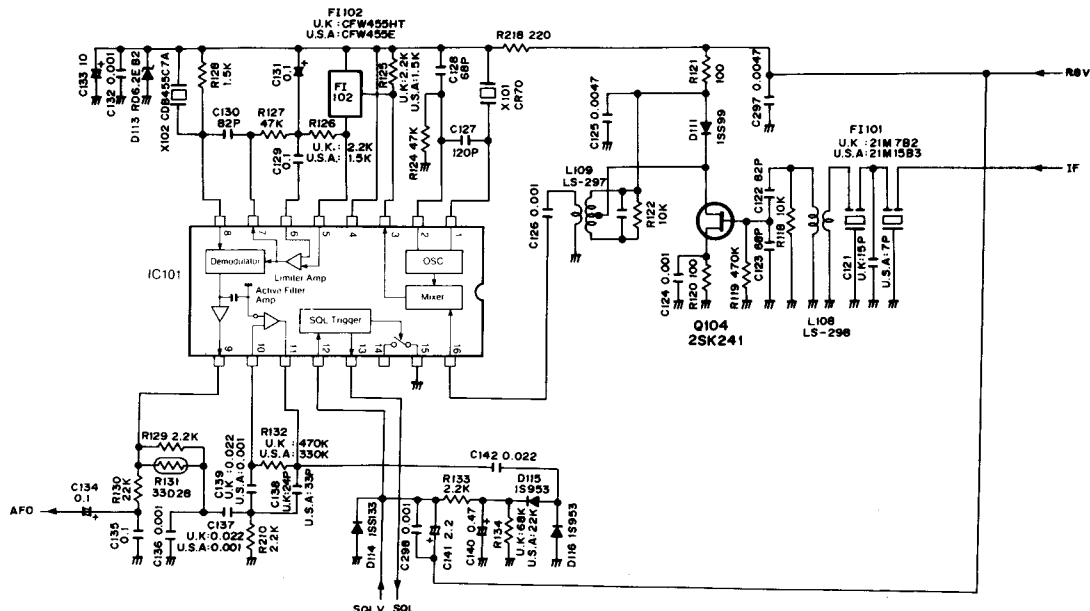


Fig. 4-2 IF Circuit



#### 4-1-4 AF CIRCUIT (LOGIC UNIT)

AF signals output from pin 9 of IC101 pass through a de-emphasis circuit (R130, C135) and are applied to high-pass filter IC407B and IC407A. The de-emphasis circuit is an integrator circuit which has 6dB/oct. frequency characteristics. IC407A suppresses subaudible tone signals.

Output signals from pin 1 of IC407A are amplified at Q415, pass through the [VOLUME] CONTROL and audio switch Q413, and are then amplified at power amplifier IC406 to drive the speaker. Q415 is also used as a high-pass filter, and Q414 and Q413 are audio switches which mute audio signals when the R-MUT signal appears or the squelch closes.

#### 4-1-5 SQUELCH CIRCUIT (MAIN UNIT)

A portion of signals from pin 9 of IC101 is fed to active filter pin 10 of IC101 where it collects noise components of 20kHz or more. The noise components are then rectified by D115 and D116 for conversion to DC voltage and are fed to the squelch trigger circuit (pin 12 of IC101). The [SQUELCH] CONTROL is also connected to pin 12 of IC101 to adjust converted voltage.

A "HIGH" or "LOW" squelch control signal is output from pin 13 of IC101 and is then applied to pin 15 of CPU IC401 on the LOGIC UNIT.

Pin 30 of IC401 becomes "HIGH" as the R-MUTE signal while both pin 15 (SQL) and pin 7 (CTCSS signal) receive "LOW". The R-MUTE signal is applied to Q413 and Q414 to mute the audio signals.

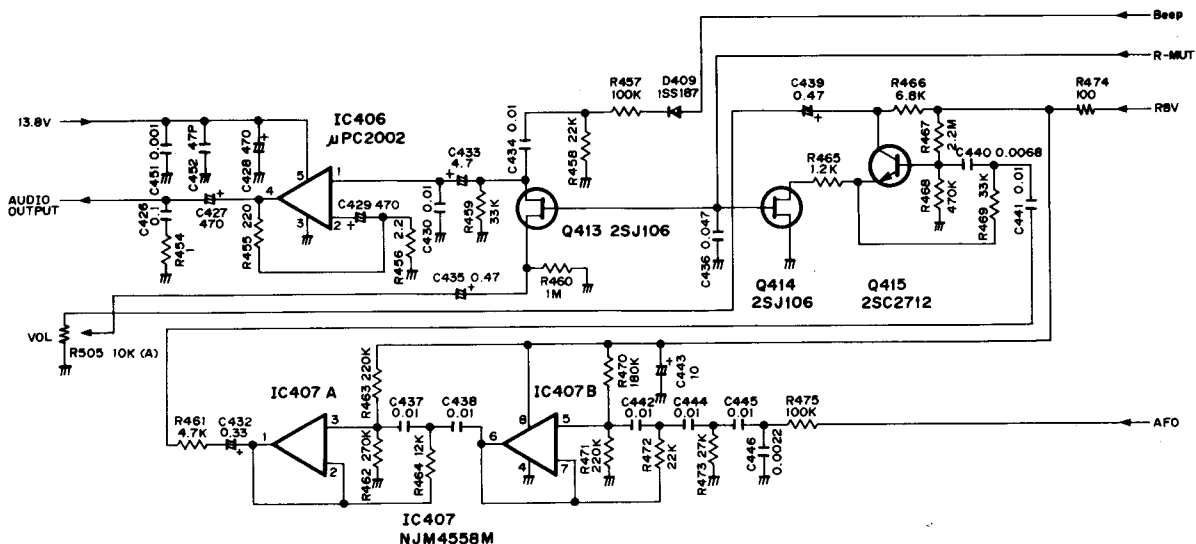


Fig. 4-3 Audio Amplifier and Squelch Circuits

## 4-2 TRANSMITTER CIRCUITS

### 4-2-1 MICROPHONE AMPLIFIER CIRCUIT (MAIN UNIT)

AF signals from the microphone pass through the pre-emphasis circuit (C410 and R434) which has 6dB/oct. frequency characteristics in the 300Hz~3kHz frequency range. AF signals are then amplified at low-noise amplifier Q412, pass through mic gain pot R437 and are amplified at limiter amplifier IC405A. R441 adjusts the symmetrical waveform of the limiter amplifier output.

Output from the limiter amplifier is similar to a rectangular waveform and includes harmonic components. Harmonic components higher than 3kHz are attenuated by splatter filter IC405B.

AF signals from pin 6 of IC405B pass through modulation-adjusting trimmer pot R451 and then are applied to the VCO circuit for performing frequency modulation.

### 4-2-2 BUFFER AMPLIFIER CIRCUIT (PLL UNIT)

Oscillated signals from the VCO circuit (including modulated signals) are buffer amplified at Q107, pass through isolator L117, are buffer amplified at Q108 and then pass through transmit/receive switching circuit D123 and D124. They are then amplified at pre-driver Q110 and Q111 and at driver Q112, thus obtaining wideband 200mW drive power.



### 4-2-3 POWER AMPLIFIER CIRCUIT

Amplified signals at Q112 are power amplified at IC108 and obtain more than 25W (10W: #01, #02, #06) RF output power.

Output power from IC108 passes through an antenna switching circuit, a high-pass filter, and is then applied to the ANTENNA CONNECTOR.

### 4-2-4 APC CIRCUIT

RF signals from the output of IC107 are detected by D130 and D131 and are converted to DC voltage. They are then fed to inverting amplifier IC107 to control the input current of IC108 using Q114 and Q115.

Divided T8V is applied to pin 3 of IC107 as the reference voltage that determines RF output power with R179.

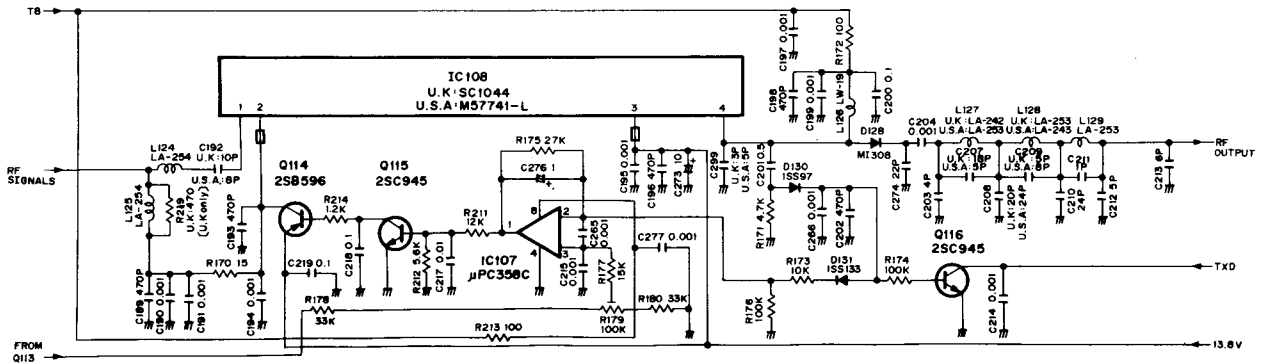


Fig. 4-4 Power Amplifier and APC Circuit

## 4-3 PLL CIRCUITS

The PLL circuits adopt a dual modulus prescaler system. The circuits generate the desired frequency directly in the VCO circuit.

The PLL circuits are composed of prescaler IC103 and PLL IC104.

### 4-3-1 REFERENCE FREQUENCY CIRCUITS (MAIN UNIT)

IC104 incorporates a swallow counter of 6 binary bits, a programmable counter of 11 binary bits, a phase comparator, a charge pump and a frequency divider for the reference frequency.

A 5.12MHz (6.4MHz: #01, #06) signal is oscillated at reference oscillator Q117 and X103, and is fed to pin 17 of IC104. IC104 divides the frequency by 1/1024 and a

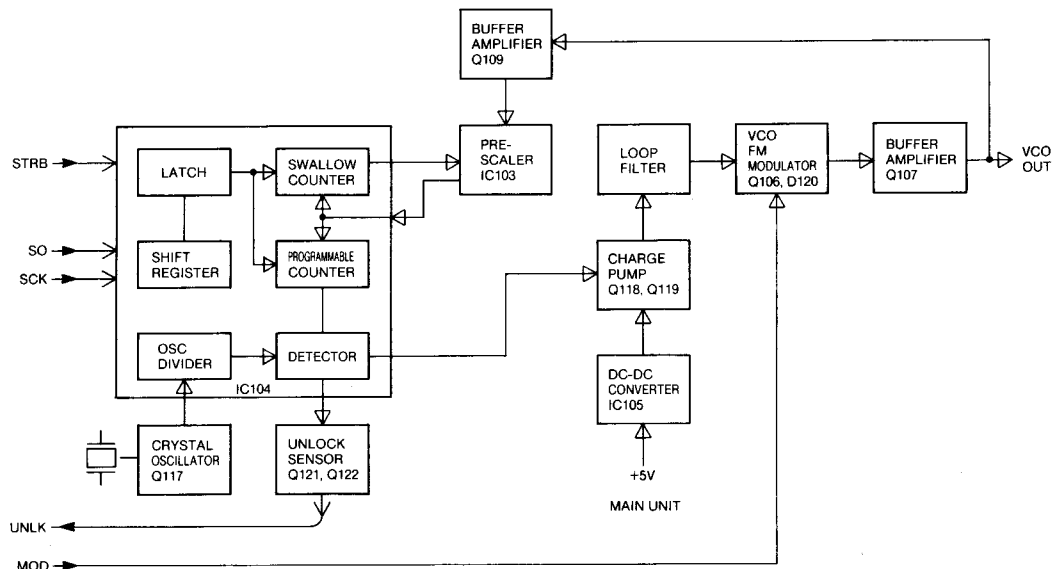
reference frequency of 5kHz (#01, #06 6.25kHz) is obtained. The reference frequency is fed to pin 7 of IC104.

### 4-3-2 DUAL MODULUS PRESCALER (MAIN UNIT)

Signals from the VCO circuit (Q106) are buffer amplified at Q107 and Q109, and divided N times at IC103 and IC104. Signals are then phase detected at IC104 and the detected signals are output from pins 12 and 13. IC103 is a prescaler that divides the input signals by 1/64 or 1/65.

N-data is the number of times the desired frequency is divided by the reference frequency. The desired frequency is transmit frequency in transmit mode and the 1st LO frequency in receive mode.

$$N = \frac{\text{Desired frequency}}{\text{Reference frequency}}$$



### 4-3-3 LOOP FILTER (MAIN UNIT)

Output from pins 12 and 13 of IC104 is fed to a charge pump consisting of Q118 and Q119, and is then applied to a lag-lead type loop filter consisting of R203~R205 and C249. D137 and D138 shorten PLL lockup time. This output controls D121 and D122 in the VCO circuit.

IC105 is a DC-DC converter that generates approximately 20V and applies it to the charger pump to obtain a wide lock voltage range.

Q120 amplifies the PLL lock voltage to control varactor diodes D101~D110 in the RF bandpass filter stage.

### 4-3-4 VCO UNIT (MAIN UNIT)

The VCO circuit (Q106) employs a Clapp Oscillator circuit. The VCO free-run frequency is shifted by inductive reactance with D118 and D119.

In receive mode, R8V turns D119 and D120 ON, and C145 and C146 are not connected for oscillating frequencies. In transmit mode, T8V turns D118 ON, and D120 is reverse biased. Thus oscillating frequencies are shifted higher than receive frequencies. Microphone signals from IC405B change the capacitance of D120 to make FM modulation.

Thus the VCO circuit oscillates over a wide frequency range and stable oscillation is controlled by varactor diodes D121 and D122.

### 4-3-5 UNLOCK CIRCUIT (PLL UNIT)

When the PLL circuit is unlocked, pin 10 of IC104 is "LOW" and a "LOW" signal is applied to the CPU via a time constant circuit consisting of Q121, Q122, R198 and C284.

## 4-4 LOGIC CIRCUITS

The main part of the logic circuit consists of an 8-bit CMOS and 2K-byte CMOS RAM, and controls operating and subaudible tone frequencies.

### 4-4-1 CPU (LOGIC UNIT)

Following are CPU descriptions for all functions related to the controls and switches on the front panel of the IC-V200.

PORT NUMBER	DESCRIPTION
DB0~DB7	These are data exchange ports between a 2k RAM and CPU. DB0~DB3 are used as matrix input ports.
PE0~PE15	These are ports which can be programmed to change between address and output ports. PE0~PE10 are used as an address signal. PE15 is used as a RAM selecting signal. PE0~PE3 and PE14 are used as an output signal of the matrix circuit.

PORT NUMBER	DESCRIPTION
PA4 (TMUT)	Outputs at a HIGH level at approx. 80msec. when changing from receive to transmit mode, preventing unwanted signal output. If the PLL is unlocked in transmit mode, it remains at a HIGH level.
PA3 (RMUT)	Outputs at a HIGH level when muting of the receive audio sound is needed.
PA0 (STRB)	Outputs a latch signal for PLL data.
PB7 (MONI)	Input port for the MONITOR SWITCH.
PB6 (T/R)	Outputs a signal for the T/R switching of the tone IC chip.
PB5~PB0 (S5~S0)	Outputs tone data.
PC3 (FUNC)	Input port for the FUNCTION SWITCH. At a LOW level when turning power ON and the CPU enters the cloning mode.
PC2 (SEND)	Input port for the T/R switching signal. At a HIGH level in transmit mode and can also be used as an input port for cloning.
PC1 (SQL)	Input port for squelch signals. At a HIGH level when the squelch circuit is open.
PC0 (UNLK)	Input port at a LOW level when PLL is unlocked.
S0	Output port for the shift register inside the CPU. Outputs N-data.
SCK	Outputs the timing signal of S0 data being transmitted. S0 signals vary at a trailing edge of the SCK timing signal.
INT0	Input port for the tone decoder IC chip. Tone decoder data is input when the port is at a HIGH level.
INT1	This port becomes HIGH when entering standby mode. The port is at a HIGH level when turning power OFF, and at a LOW level when turning power ON.
TO	Outputs beep tone signals.
WR	At a LOW level when data are written to the external RAM.
RD	At a LOW level when the CPU reads data from the external RAM.



#### 4-4-2 RAM (LOGIC UNIT)

RAM IC302 ( $\mu$ PD446G) has an 8-bit CMOS 2048-word capacity.

This RAM memorizes the current channel, priority channel, N-data for transmit and receive, tone numbers with relative tone frequencies and shift frequencies.

Data reading and writing are processed by CPU ports PE0~PE10. Following is the timing chart for memory read and write.

#### 4-4-3 RESET CIRCUIT (LOGIC UNIT)

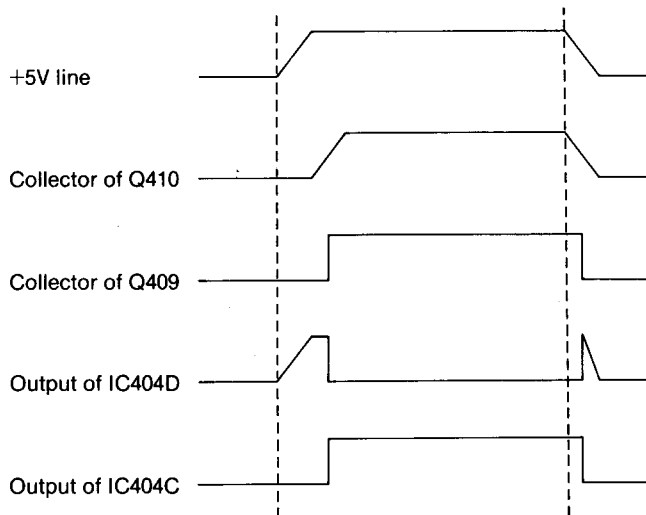
After power is ON, Q410 turns ON via the charging current of C406. The collector of Q410 is then at a LOW level. After C406 is completely charged, the collector and emitter are ON. The collector is at a HIGH level when Q409 is ON.

When the collector of Q409 is at a HIGH level, output from IC404D is at a LOW level. Output from IC404C is then changed from LOW to HIGH.

The CPU is reset after the oscillation of X401 is stabilized by the delay circuit which consists of R510 and C510.

When the power is OFF, the collector and emitter are OFF and output from IC404D becomes HIGH. Thus, the CPU enters standby mode.

Following is a timing chart for resetting the CPU.



#### 4-5 INDICATOR CIRCUIT

There are four indicators on the front panel: [POWER], [TX], [BUSY] and [CALL].

##### 4-5-1 POWER INDICATOR (RED)

This indicator lights up when power to the transceiver is turned ON. It is powered by common 8V from IC102 on the MAIN UNIT.

##### 4-5-2 TX INDICATOR (RED)

This indicator lights up in transmit mode and uses part of the APC detector signals, lighting up via Q116.

##### 4-5-3 BUSY INDICATOR (GREEN)

This indicator lights up when the squelch is open through Q404 using a signal from pin 13 of IC101.

##### 4-5-4 CALL INDICATOR (YELLOW)

This indicator lights up when a specified tone is received by the IC-V200. It lights up via Q405 using a DOUT signal on the CTCSS UNIT.

##### 4-5-5 OTHER CIRCUITS

The PLL circuit is unlocked when both the [BUSY] and [TX] indicators light up in receive mode as the squelch opens.

This indicator lights up while the UNLK signals from pin 10 of IC103 pass through Q407.

#### 4-6 CTCSS UNIT

AF signals are sent from the AFIN terminal to IC2 through a low-pass filter consisting of IC1(A) and (B).

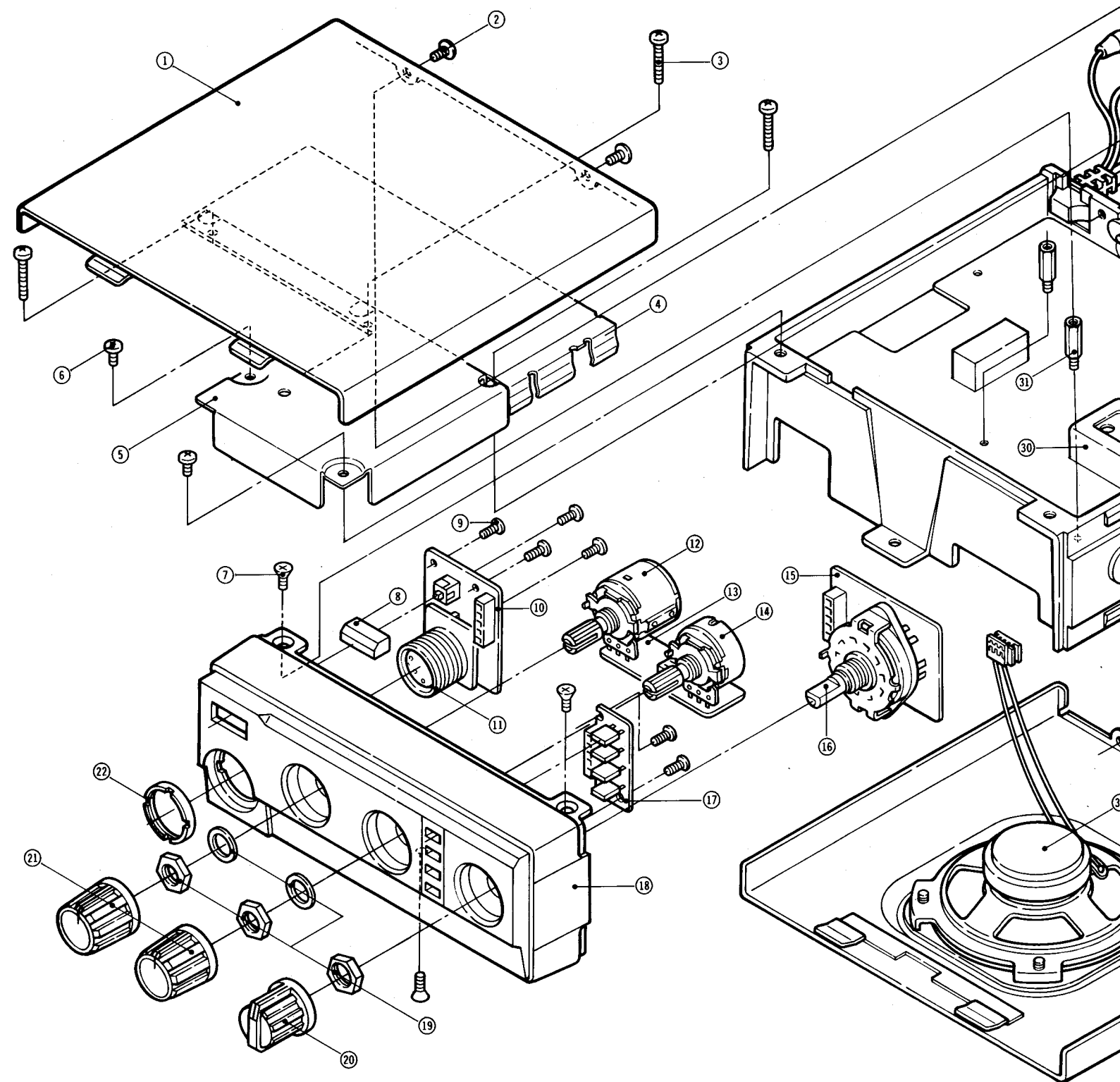
IC2 is an encoder/decoder IC chip for subaudible tones. High frequency stability is obtained since a crystal unit is used for the reference oscillation.

When the received tone frequency is the same as the programmed tone frequency, DETOUT, pin 23 of IC2, becomes HIGH. If both frequencies are not matched, the terminal remains at a LOW level.

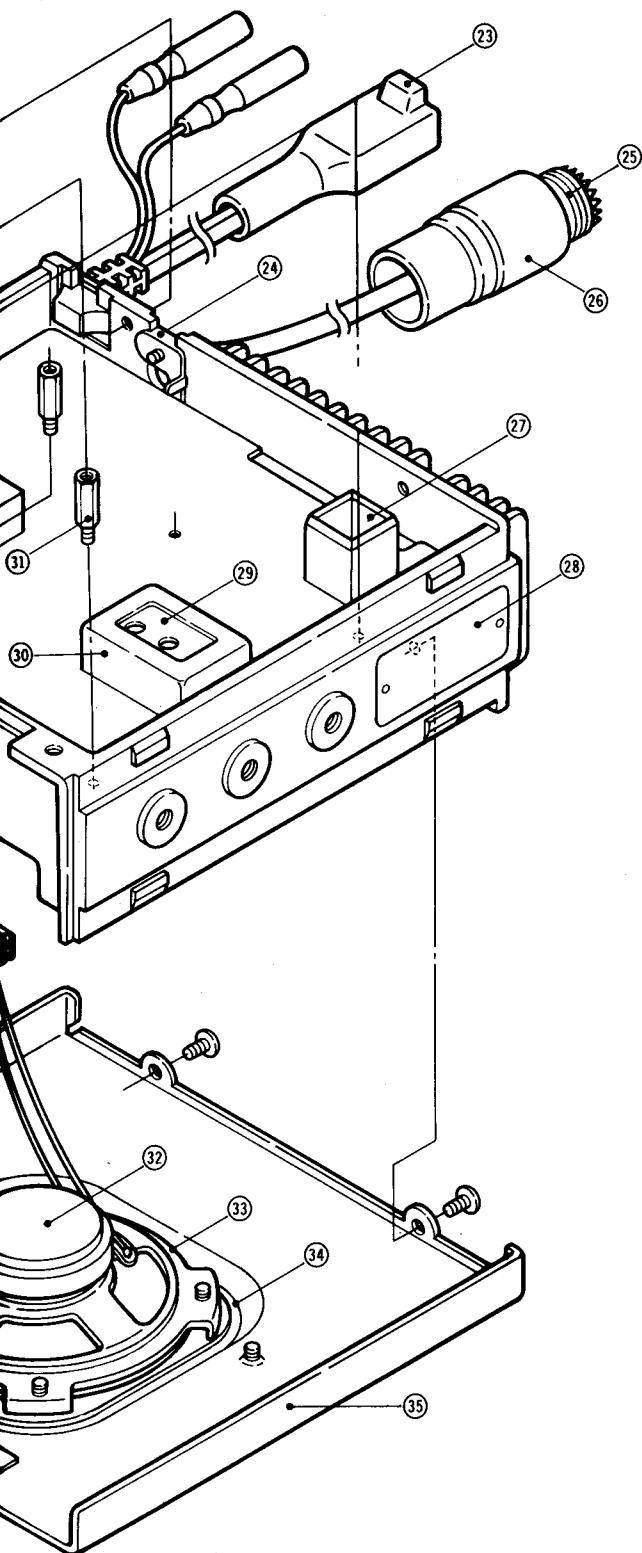
In transmit mode, the desired tone is output from TXOUT, pin 26 of IC2, and the tone is applied to the modulator circuit.

## SECTION 5 MECHANICAL PARTS AND ASSEMBLY

### 5-1 MECHANICAL PARTS

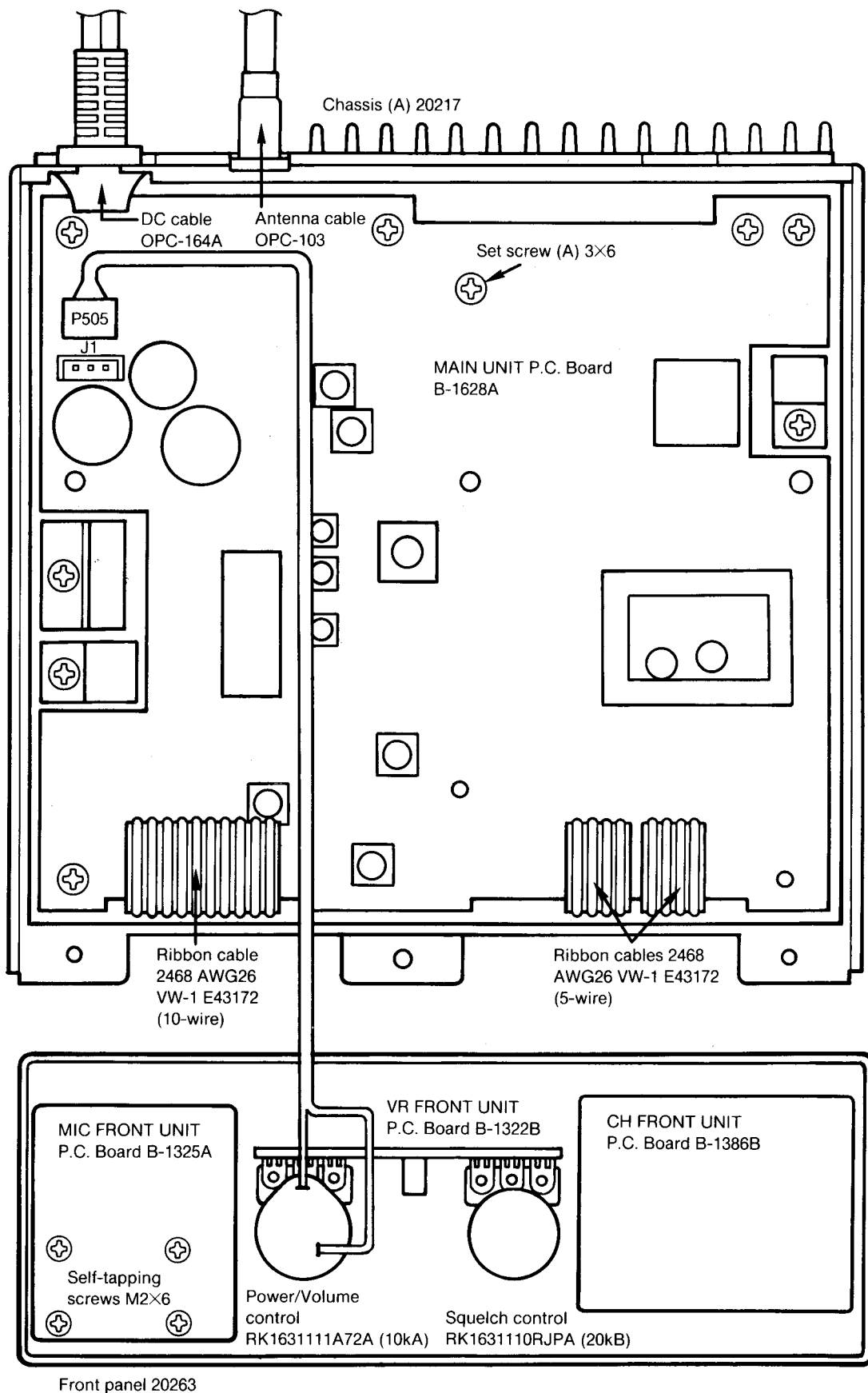






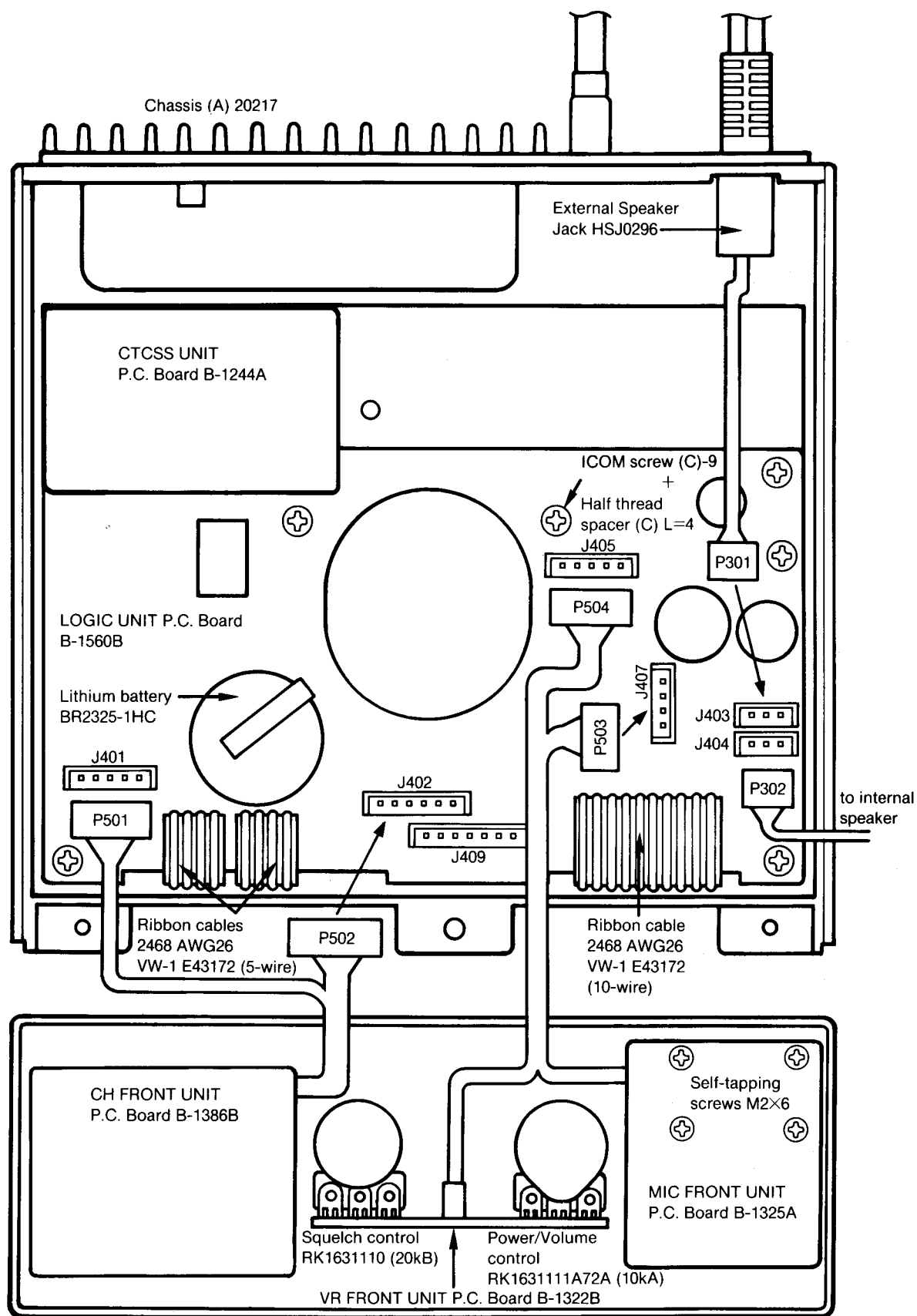
LABEL NUMBER	DESCRIPTION	ORDER NUMBER	QTY.
①	Top Cover (B) 30410 black	8110001860	1
②	Binding head Screw M3×6	8810002960	4
③	Set screw (G) M3×16	8810000290	3
④	PA Shield Plate 43661	8510004460	1
⑤	Main Shield Case 30529	8510004340	1
⑥	Screw M3×4	8810000210	2
⑦	Flathead Screw M3×6	8810003030	3
⑧	K-75 Monitor Button 43459	8610002410	1
⑨	Self-tapping Screw 2×6 B0	8810001000	6
⑩	Mic Front Unit P.C. Board B-1325A	0910014091	1
⑪	Mic Connector FM14RS-7SS	6510004820	1
⑫	Volume/Power Control RK1631111A72A (10kA)	7210001160	1
⑬	VR Front Unit P.C. Board B-1322B	0910014062	1
⑭	Squelch Control RK1631110RJPA (20kB)	7210001170	1
⑮	CH Front Unit P.C. Board B-1386B	0910014772	1
⑯	Channel Select Switch SRRM1C	2210000520	1
⑰	LED Front Unit P.C. Board B-1324	0910014080	1
⑱	Front Panel (B) (C-02419) 20263	8210002810	1
⑲	Included with switch and control assemblies	—	—
⑳	N-109-1 Knob 43460	8610002420	1
㉑	N-110 Knob 43461	8610002430	2
㉒	Mic Connector Ring (assembly) FM14RS-7SS	—	1
㉓	DC Cable and Connector assembly OPC-164A	8900001660	1
㉔	Cable Holder 42965	8930007480	1
㉕	Antenna Cable and Connector assembly OPC-103	8900001050	1
㉖	M-Type Cap 42894	6950000040	1
㉗	194 Shield Case 42273	8510000020	1
㉘	Chassis (A) 20217 black	8010004090	1
㉙	VCO Case (A) (Top) 42010	8510002730	1
㉚	331 VCO Case 43715	8510004470	1
㉛	Standoff (F) 40033	8930000100	2
㉜	Speaker 66F09N-7	2510000200	1
㉝	Speaker Holder 42944	8930006390	1
㉞	57 Speaker Spacer 42082	8930004950	1
㉟	Bottom Cover (B) 30442 black	8110001870	1

## 5-2 MAIN AND FRONT UNITS CONNECTOR ASSEMBLY





## 5-3 LOGIC AND FRONT UNITS CONNECTOR ASSEMBLY

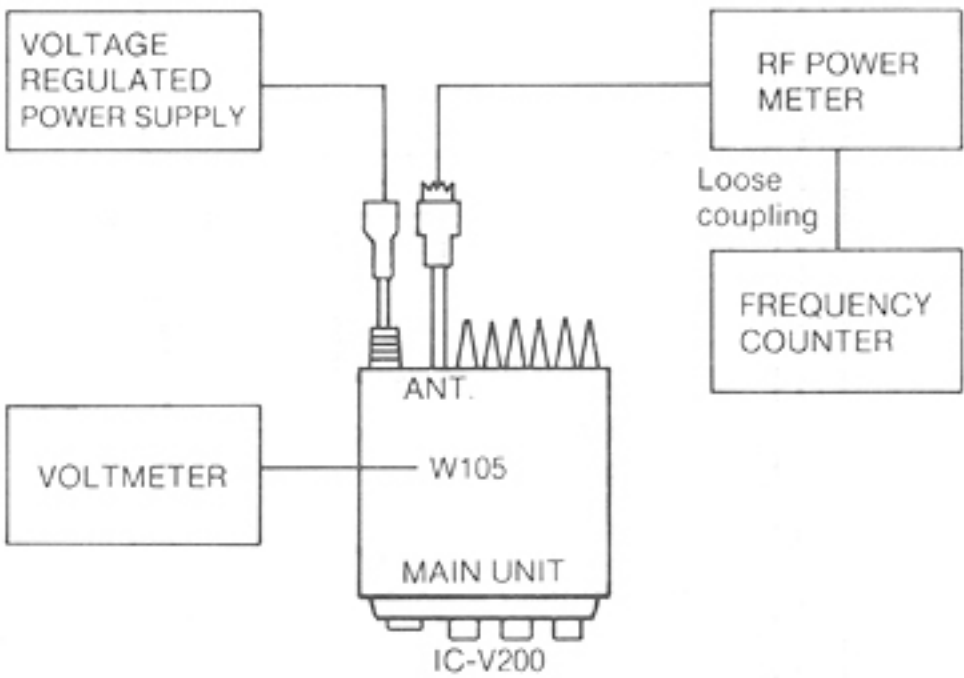


Front panel 20263

## SECTION 6 ADJUSTMENT PROCEDURES

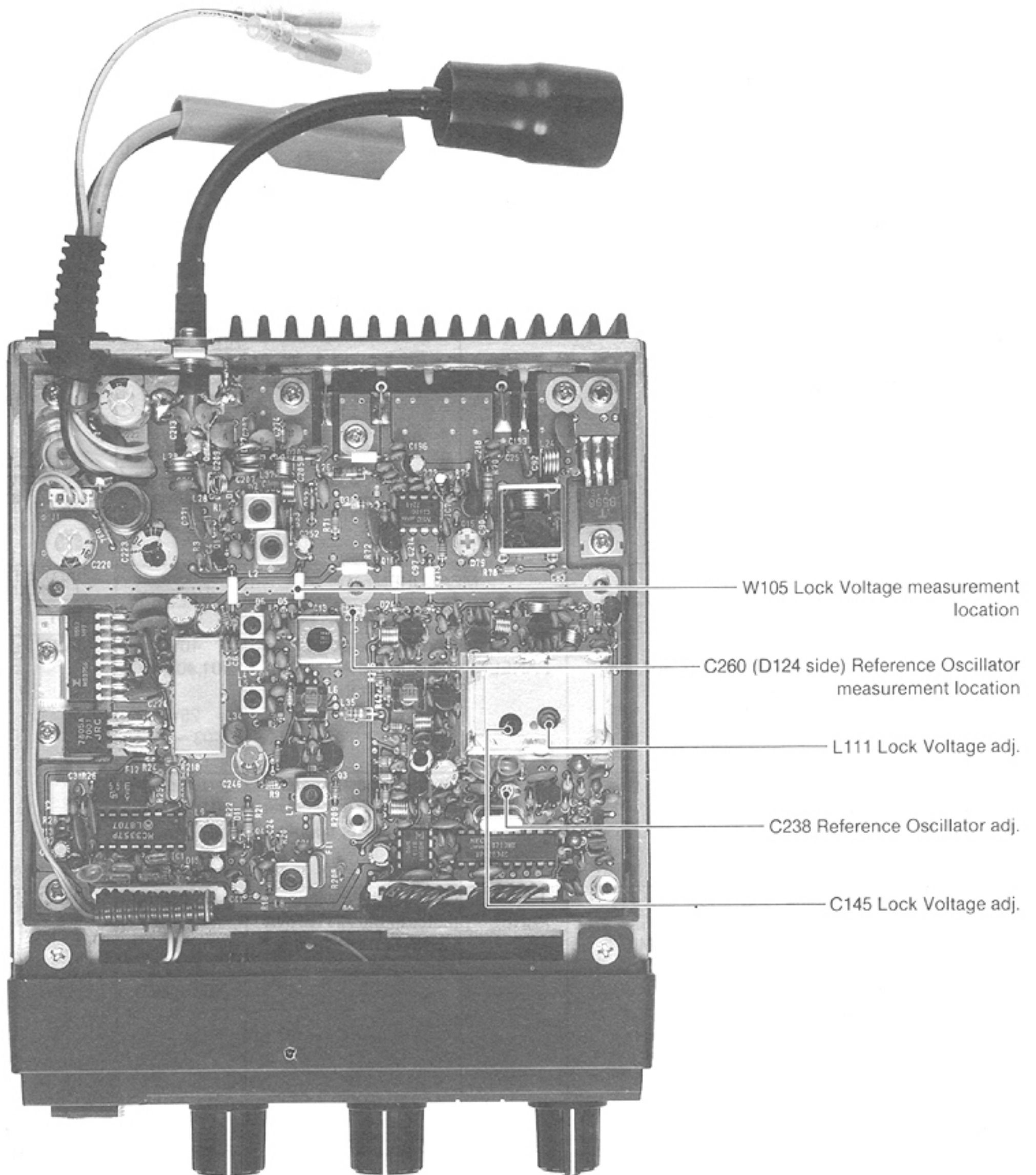
**NOTE:** The operating frequency is set by cloning from the IC-H16. See p. 10 of the PROGRAMMING MANUAL (A-0884).

### 6-1 PLL ADJUSTMENT

TEST INSTRUMENTS REQUIRED				MEASUREMENT CONNECTION LOCATION		
(1) VOLTAGE REGULATED POWER SUPPLY • Output voltage : 13.8V DC $\pm$ 10% • Current capacity : 10A or more  (2) RF POWER METER • Terminated type • Measuring range : 5 ~ 30W • Frequency minimum : At least 180MHz • Impedance : 50 $\Omega$  (3) VOLTMETER • Input impedance : 40k $\Omega$ /V DC or better  (4) FREQUENCY COUNTER • Frequency minimum : At least 180MHz • Frequency accuracy : 1ppm or better • Sensitivity : 100mV or better						
ADJUSTMENT		ADJUSTMENT CONDITIONS	MEASUREMENT		ADJUSTMENT POINT	
			UNIT	LOCATION	VALUE	UNIT ADJUST
LOCK VOLTAGE	1	• Operating frequency: 146.00MHz • Receive mode	MAIN	Connect the voltmeter to W105.	3.0V	MAIN L111
	2	• Transmit mode			3.0V	C145
	3	• Operating frequency: 174.00MHz • Receive mode			13 ~ 16V	Verify
	4	• Transmit mode			16 ~ 19V	Verify
REFERENCE OSCILLATOR	1	• Operating frequency: 146.00MHz	MAIN	Connect the voltmeter to C260 (D124 side).	124.200MHz	MAIN C238



## MAIN UNIT



**NOTE:** For complete part numbers, "100" must be added to each binary numeral on the MAIN UNIT.

## 6-2 TRANSMITTER ADJUSTMENT

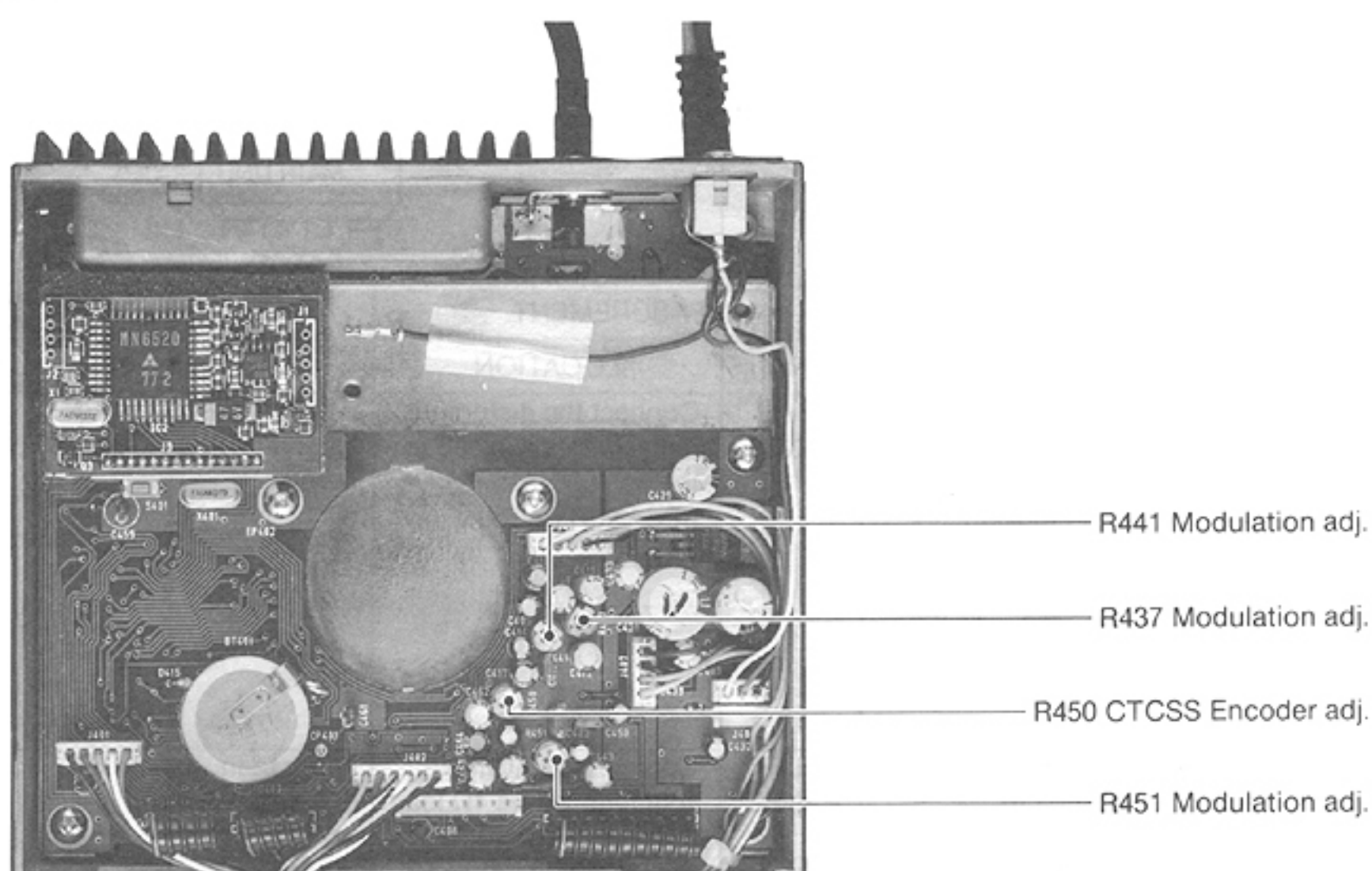
TEST INSTRUMENTS REQUIRED	MEASUREMENT CONNECTION LOCATION
<p>(1) VOLTAGE REGULATED POWER SUPPLY</p> <ul style="list-style-type: none"> <li>Output voltage : 13.8V DC <math>\pm 10\%</math></li> <li>Current capacity : 10A or more</li> </ul> <p>(2) RF POWER METER</p> <ul style="list-style-type: none"> <li>Terminated type</li> <li>Measuring range : 5 ~ 30W</li> <li>Frequency minimum : At least 180MHz</li> <li>Impedance : 50<math>\Omega</math></li> </ul> <p>(3) DEVIATION METER</p> <ul style="list-style-type: none"> <li>Frequency range : 140 ~ 180MHz</li> <li>Measuring range : 0 ~ <math>\pm 5</math>kHz</li> </ul> <p>(4) AC MILLI-VOLTMETER</p> <ul style="list-style-type: none"> <li>Measuring range : 5mV ~ 10V</li> </ul> <p>(5) ATTENUATOR</p> <ul style="list-style-type: none"> <li>Attenuation : 30dB or 40dB</li> </ul>	

CW: Clockwise

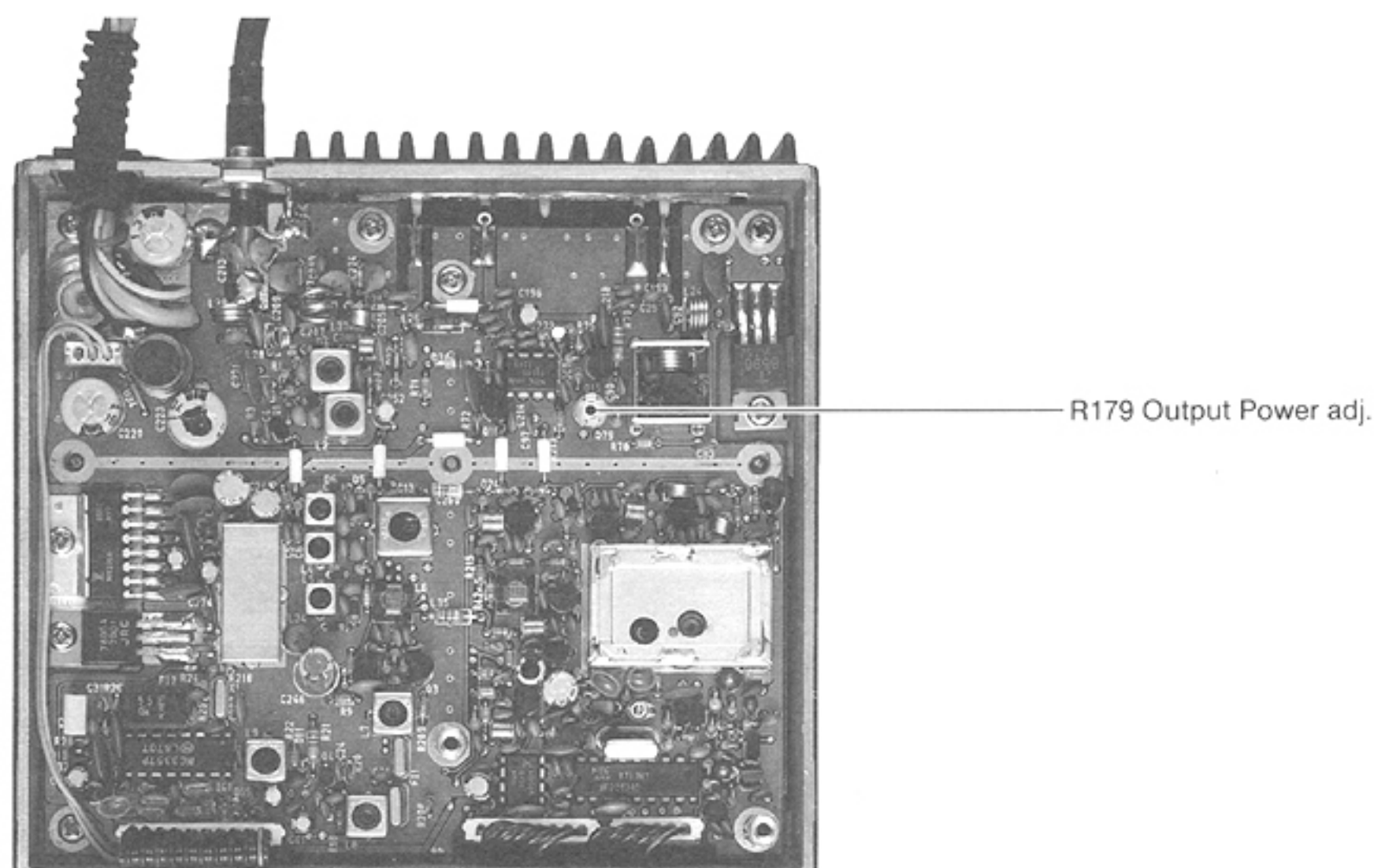
ADJUSTMENT		ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
			UNIT	LOCATION		UNIT	ADJUST
OUTPUT POWER	1	<ul style="list-style-type: none"> <li>Operating frequency: 160.00MHz (#01, #02, #06) 154.00MHz (#03) 162.00MHz (#04) 169.00MHz (#05)</li> <li>Transmit mode</li> </ul>	REAR PANEL	Connect the power meter to the ANTENNA CONNECTOR.	10W (#01, #02, #06)  25W (#03 ~ #05)	MAIN	R179
	2	<ul style="list-style-type: none"> <li>Same as above.</li> </ul>		Connect the ammeter between the transceiver and the power supply.	Less than 3A (#01, #02, #06)  Less than 6A (#03 ~ #05)		Verify
MODULATION	1	<ul style="list-style-type: none"> <li>Operating frequency: Same as above</li> <li>Apply an AF signal to the MIC CONNECTOR: 1kHz 50mV</li> <li>R437: Max. CW</li> <li>Set the deviation meter <ul style="list-style-type: none"> <li>LPF : 20kHz</li> <li>HPF : OFF</li> <li>De-emphasis : OFF</li> <li>Detector : <math>\frac{P-P}{2}</math></li> </ul> </li> <li>Transmit mode</li> </ul>	REAR PANEL	Connect the deviation meter to the ANTENNA CONNECTOR via the attenuator.	$\pm 2.2$ kHz (#01, #06)  $\pm 4.4$ kHz (#02 ~ #05)	LOGIC	R451
	2	<ul style="list-style-type: none"> <li>Same as above.</li> </ul>		Connect the oscilloscope to the deviation meter.	Symmetrical waveform.		R441
	3	<ul style="list-style-type: none"> <li>Apply an AF signal to the MIC CONNECTOR: 1kHz 5mV</li> </ul>		Connect the deviation meter to the ANTENNA CONNECTOR via an attenuator.	$\pm 1.75$ kHz (#01, #06)  $\pm 3.5$ kHz (#02 ~ #05)		R437
TRANSMIT S/N RATIO		<ul style="list-style-type: none"> <li>Operating frequency: Same as "OUTPUT POWER" above.</li> <li>Set the deviation meter <ul style="list-style-type: none"> <li>LPF : 20kHz</li> <li>HPF : 50kHz</li> <li>De-emphasis : OFF</li> <li>Detector : <math>\frac{P-P}{2}</math></li> </ul> </li> <li>Transmit mode</li> <li>Apply an AF signal to the MIC CONNECTOR: 1kHz 5mV</li> <li>Apply no AF signal to the MIC CONNECTOR.</li> </ul>	REAR PANEL	Connect the AC milli-voltmeter to the deviation meter.	The ratio between AF signals applied and not applied is as follows:  More than 35dB (#01, #06) More than 40dB (#02 ~ #05)		Verify

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
CTCSS ENCODER	<ul style="list-style-type: none"> <li>Operating frequency: 146.00MHz (#01, #02, #06) 148.00MHz (#03) 156.00MHz (#04) 164.00MHz (#05)</li> <li>Set the deviation meter LPF : 20kHz HPF : OFF De-emphasis : OFF Detector : <math>\frac{P-P}{2}</math></li> <li>TONE number: 37</li> <li>Apply no AF signal to the ANTENNA CONNECTOR.</li> <li>Transmit mode</li> </ul>	REAR PANEL	Connect the deviation meter to the ANTENNA CONNECTOR via an attenuator.	$\pm 0.25\text{kHz}$ (#01, #06)  $\pm 0.5\text{kHz}$ (#02 ~ #05)	LOGIC	R450

## LOGIC UNIT



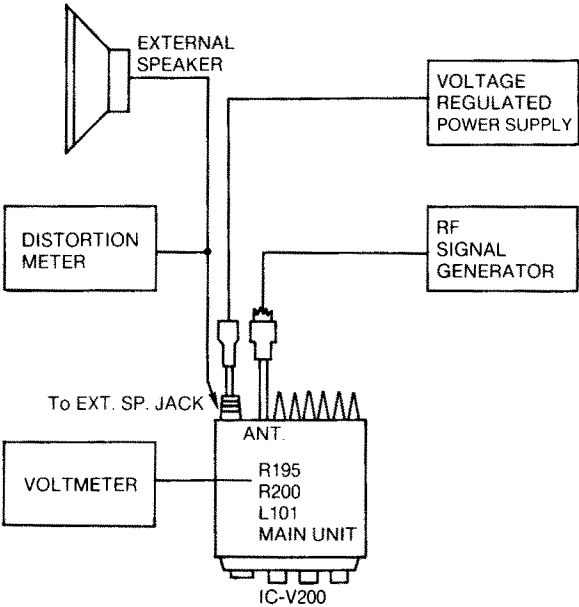
## MAIN UNIT



**NOTE:** For complete part numbers, "100" must be added to each binary numeral on the MAIN UNIT.

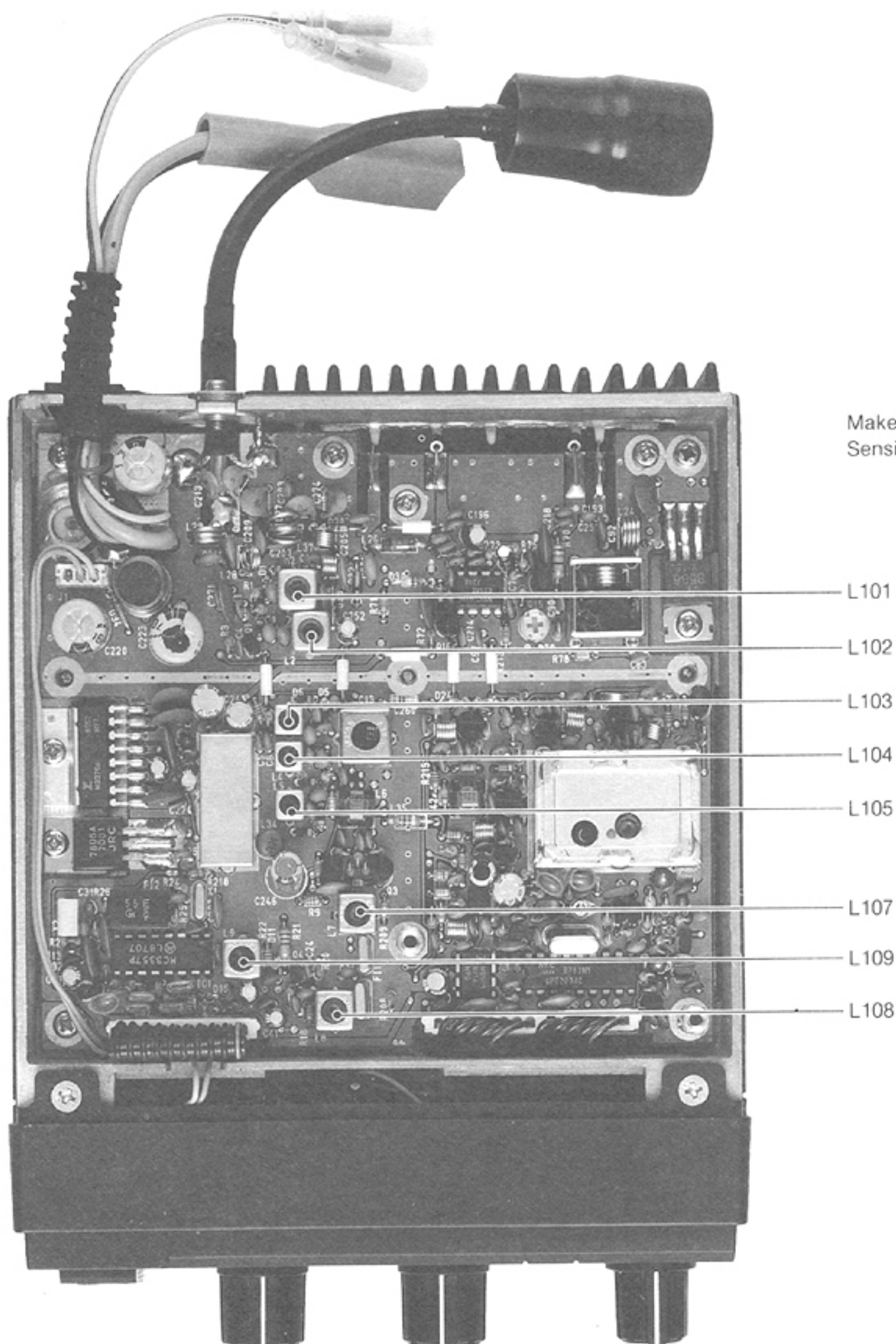


## 6-3 RECEIVER ADJUSTMENT

TEST INSTRUMENTS REQUIRED		MEASUREMENT CONNECTION LOCATION				
(1) VOLTAGE REGULATED POWER SUPPLY • Output voltage : 13.8V DC $\pm$ 10% • Current capacity : 10A or more  (2) RF SIGNAL GENERATOR • Frequency range : 140 ~ 180MHz • Output level : 0.1 $\mu$ V ~ 100mV  (3) DISTORTION METER • Frequency range : 1kHz $\pm$ 10Hz • Measuring range : 1% ~ 100%  (4) VOLTMETER • Input impedance : 50k $\Omega$ /V DC or better  (5) SPEAKER • Impedance : 4 $\Omega$						
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
SENSITIVITY	• Operating frequency: 146.00MHz • Apply an RF signal to the ANTENNA CONNECTOR. Level : 0.5 $\mu$ V (−113dBm) Mod. : 1kHz Dev. : $\pm$ 1.75kHz (#01, #06) $\pm$ 3.5kHz (#02 ~ #05) • SQUELCH CONTROL: Max. CCW • MONITOR SWITCH: ON • Receive mode	REAR PANEL	Connect the distortion meter with a 4 $\Omega$ load to the EXTERNAL SPEAKER JACK.	Minimum distortion level.	MAIN	L101 ~ L105  L107 ~ L109
AF OUTPUT	• Apply an RF signal to the ANTENNA CONNECTOR. Level : 3.2 $\mu$ V (−97dBm) • VOLUME CONTROL: Turn CW	REAR PANEL	Connect the AC milli-voltmeter with a 4 $\Omega$ load to the EXTERNAL SPEAKER JACK.	More than 3.4Vrms at 10% distortion.		Verify

CCW: Counterclockwise    CW: Clockwise

## MAIN UNIT

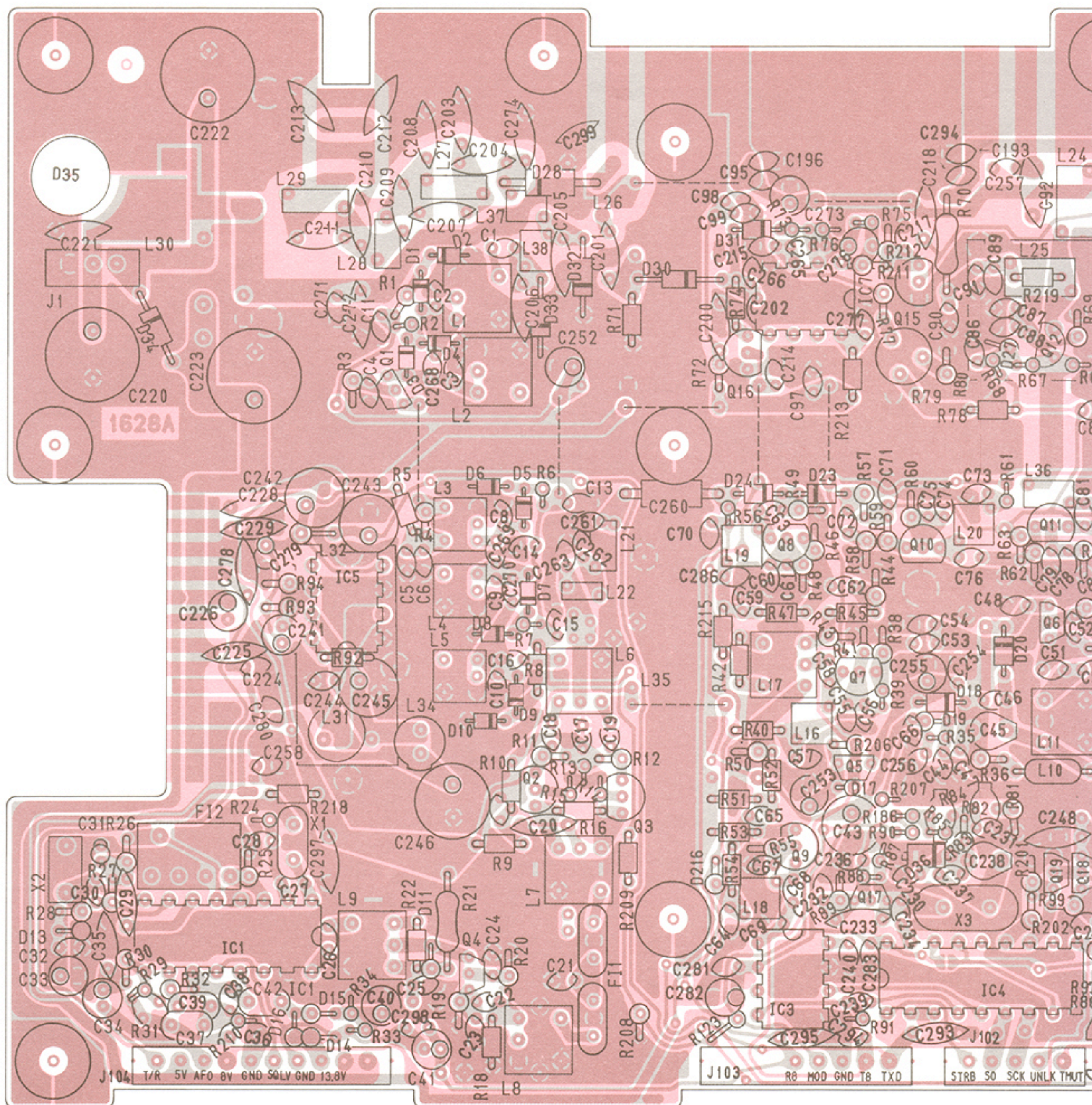


**NOTE:** For complete part numbers, "100" must be added to each binary numeral on the MAIN UNIT.



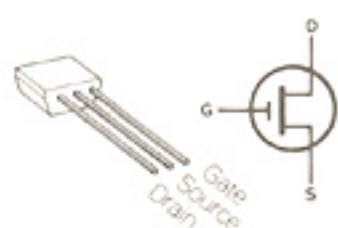
# SECTION 7 BOARD LAYOUTS

## 7-1 MAIN UNIT

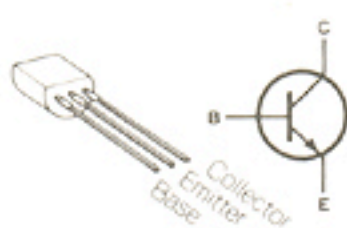


NOTE: For complete part numbers, "100" must be added to each binary numeral on the MAIN UNIT.

2SK241GR  
Q101, Q104, Q106



2SC3355  
Q102, Q103



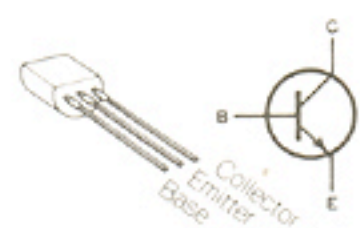
2SC2458 GR  
Q105, Q117, Q119,  
Q121, Q122



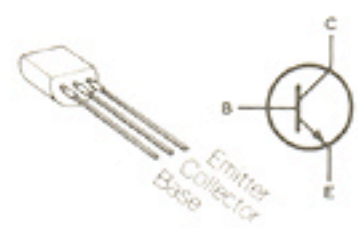
2SC2026  
Q107~Q110



2SC2407  
Q111



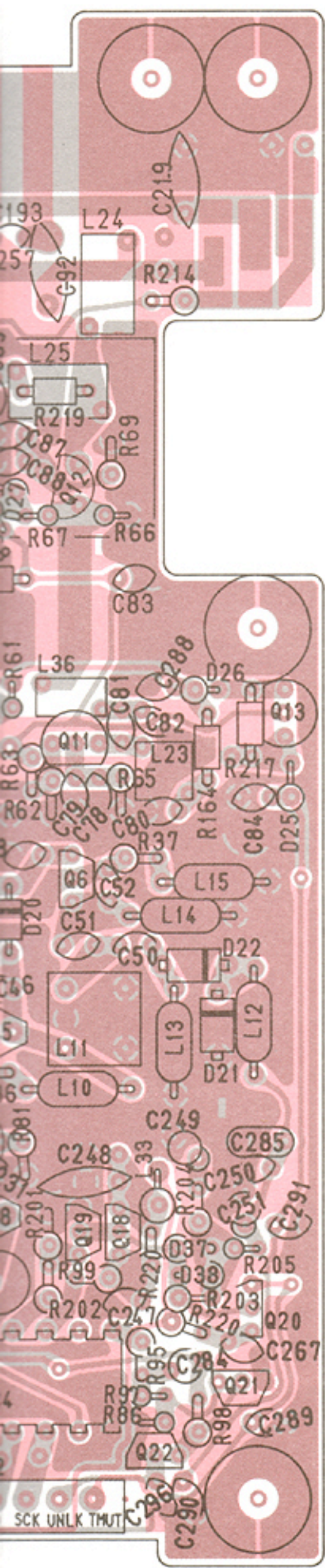
2SC2053  
Q112



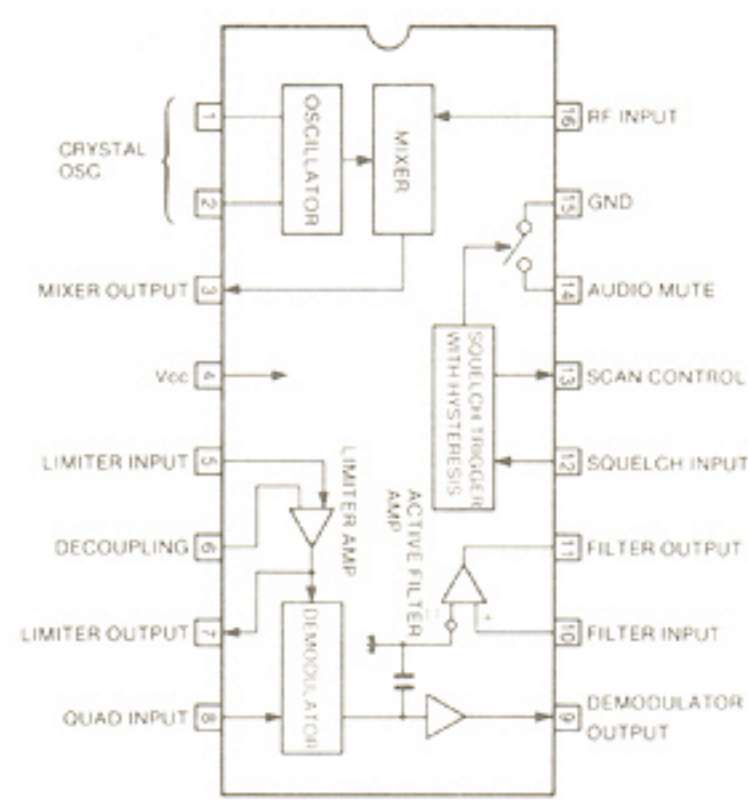
2SB5  
Q113



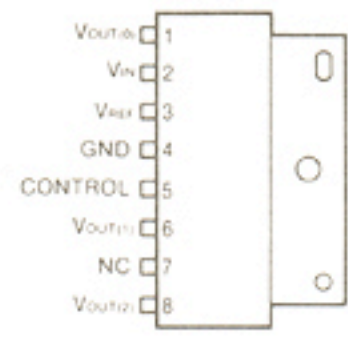




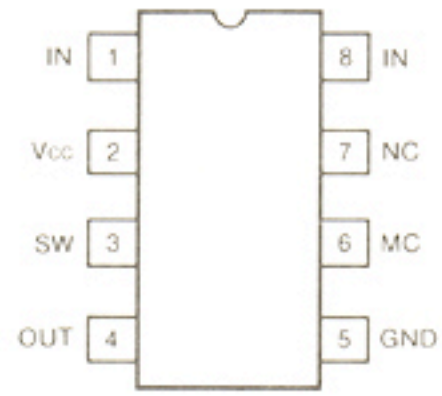
**MC3357 (LOW POWER FM IF)**  
IC101



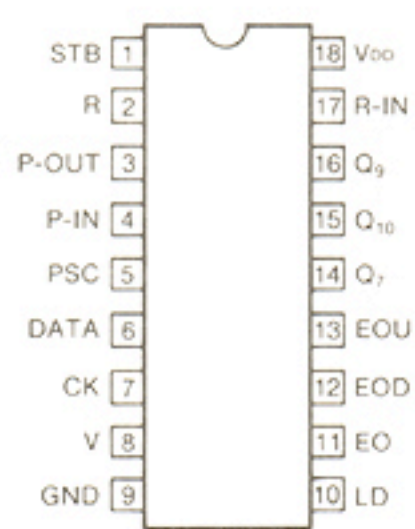
**MB3756 (VOLTAGE REGULATOR)**  
IC102



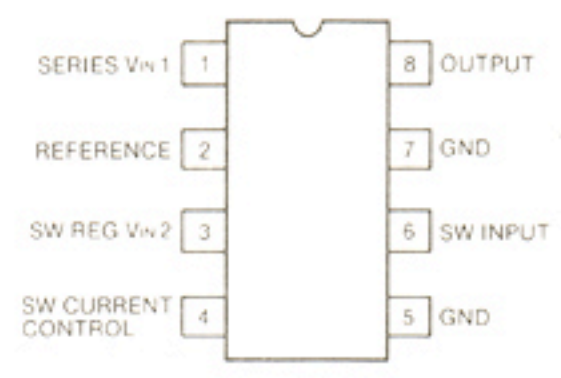
**MB504 (HIGH SPEED PRESCALER)**  
IC103



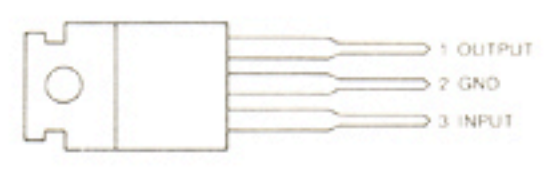
**μPD2834C (PLL FREQUENCY SYNTHESIZER)**  
IC104



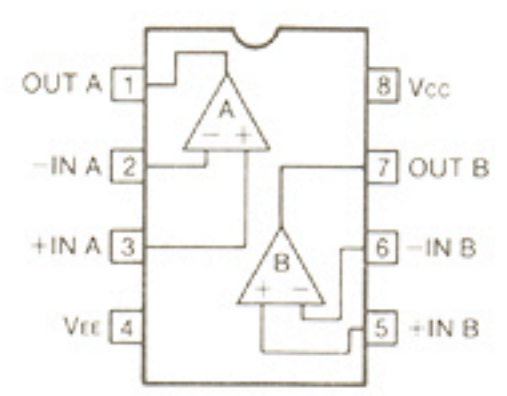
**TL499A CP (WIDE RANGE POWER SUPPLY CONTROLLER)**  
IC105



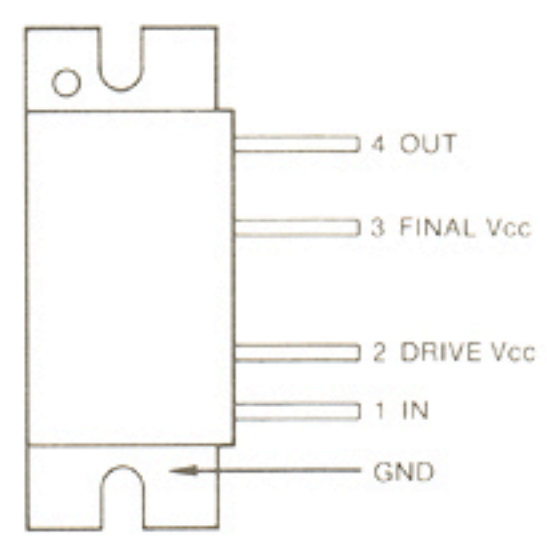
**NJM78M05 (3-TERMINAL 5V REGULATOR)**  
IC106



**μPC358C (DUAL DRIVER)**  
IC107



**SC-1044 (#01, #02, #06) (VHF POWER AMPLIFIER MODULE 145~175MHz)**  
**M57741-L (#03, 148~160MHz)**  
**M57741-M (#04, 156~168MHz)**  
**M57741-H (#05, 164~175MHz)**  
**(POWER MODULE)**  
IC108



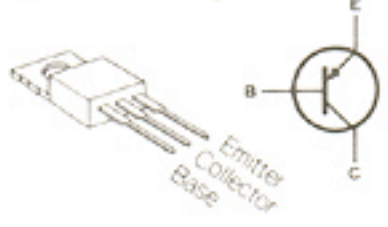
**NOTE:** The above diagrams show the top view of each IC.

N UNIT.

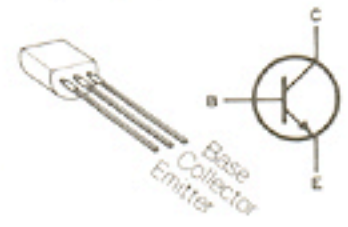
**2SB561 C**  
Q113



**2SB596 Y**  
Q114



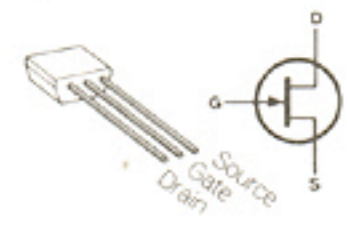
**2SC945 P**  
Q115, Q116



**2SA1048 G**  
Q118



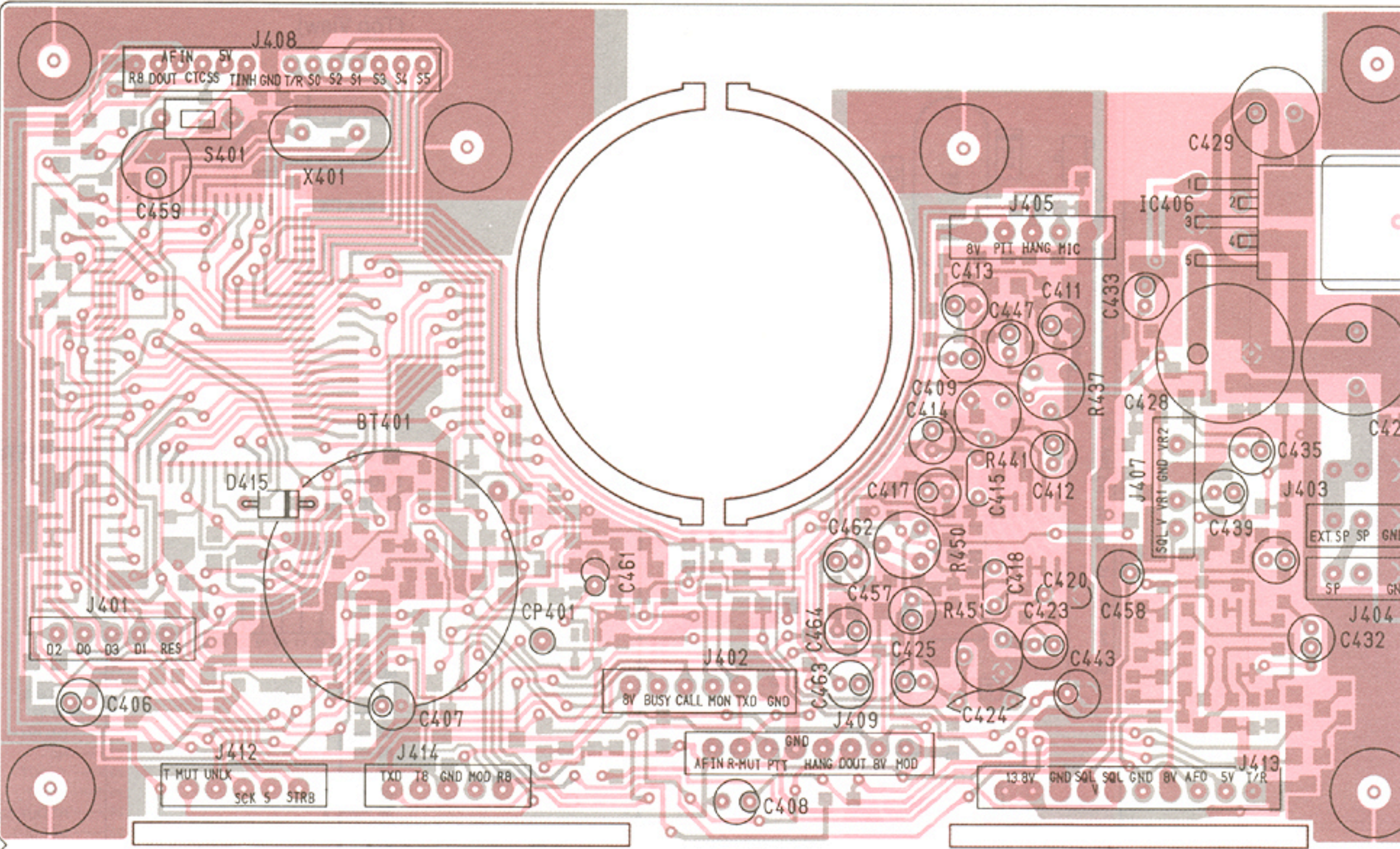
**2SK184 Y**  
Q120



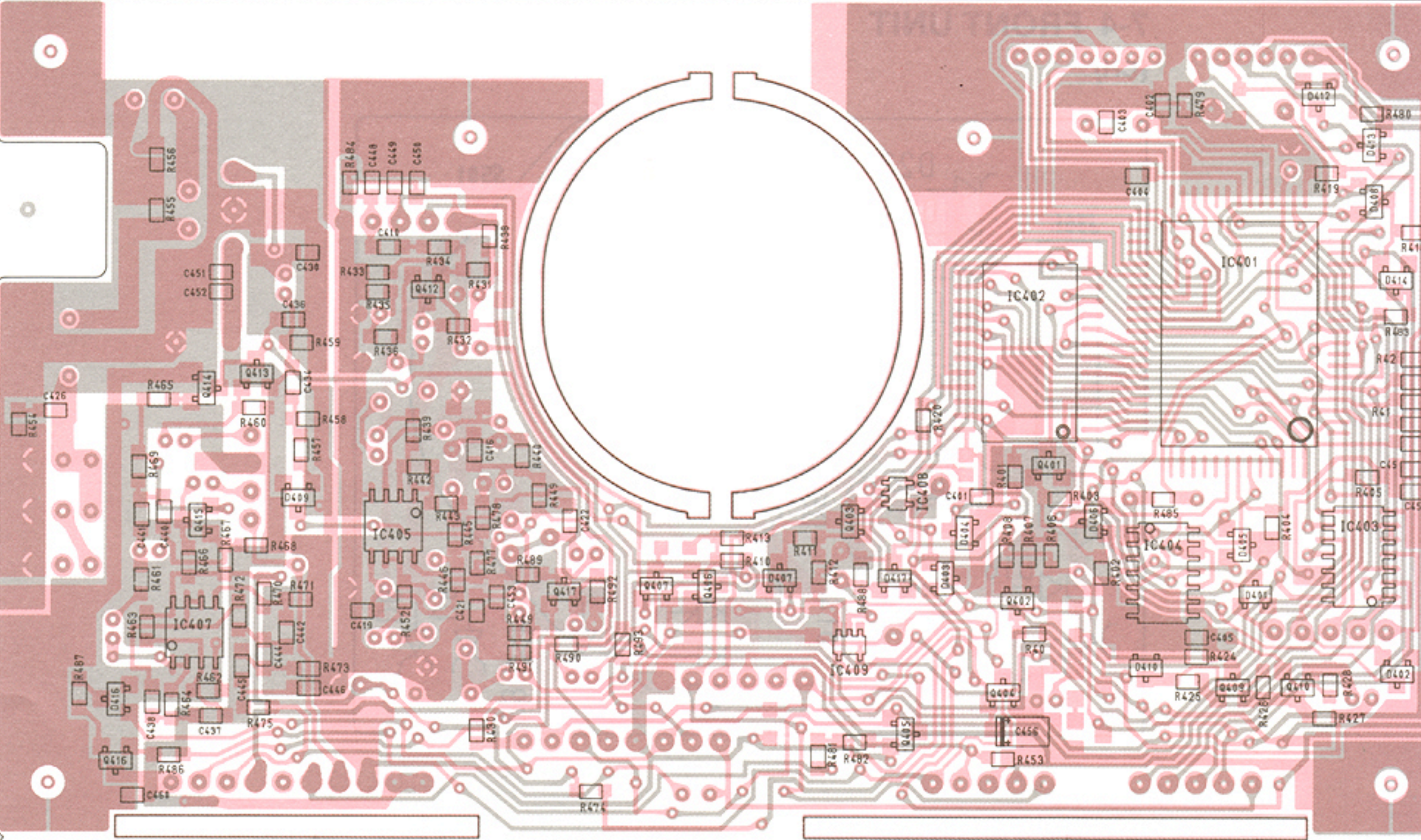


7-2 LOGIC UNIT

(Top View)

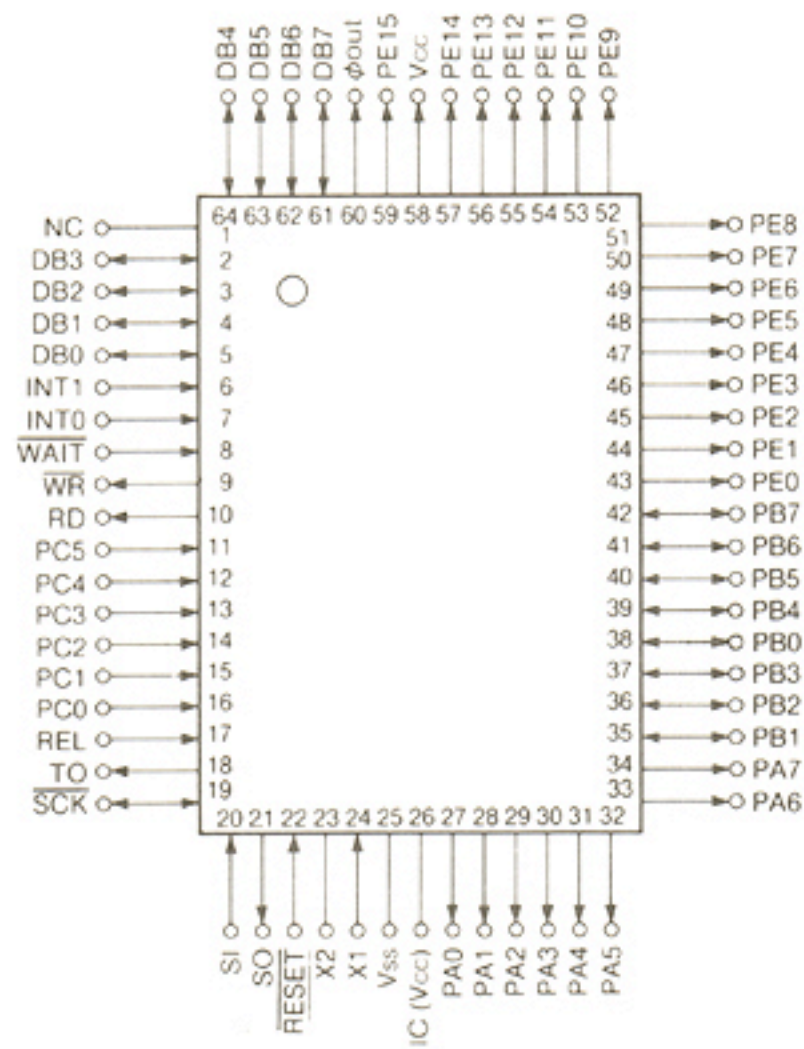


(Bottom View)

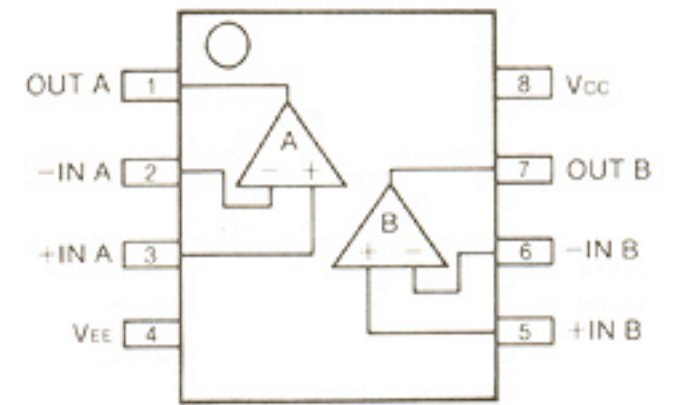




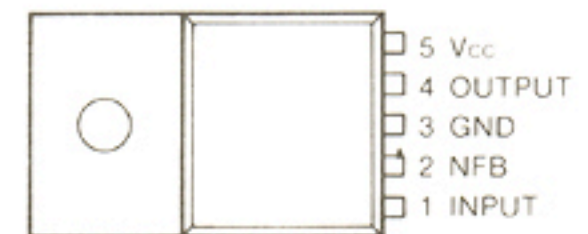
**μPD78C06AG-570-12 (MPU)**  
IC401



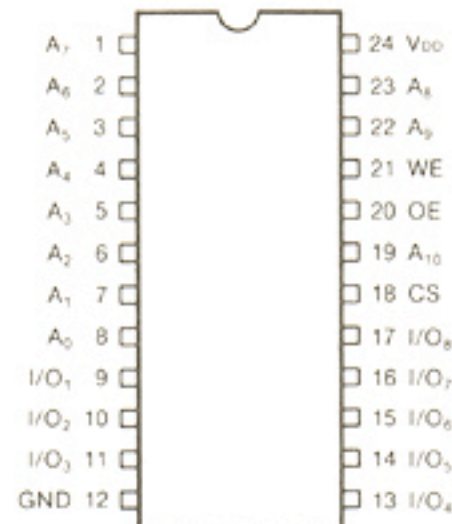
**NJM4558M (DUAL NOISE LOW AMP)**  
IC405, IC407



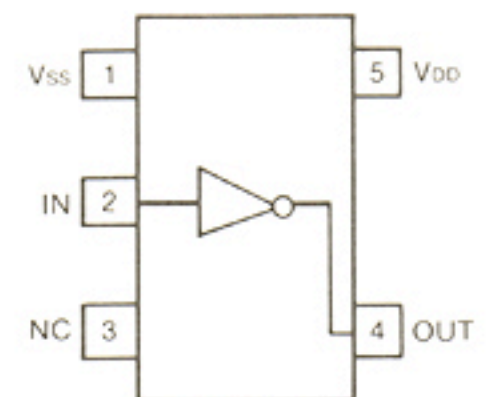
**μPC2002H (5.4W AUDIO POWER AMP.)**  
IC406



**μPD446G (16384 BIT STATIC CMOS RAM)**  
IC402

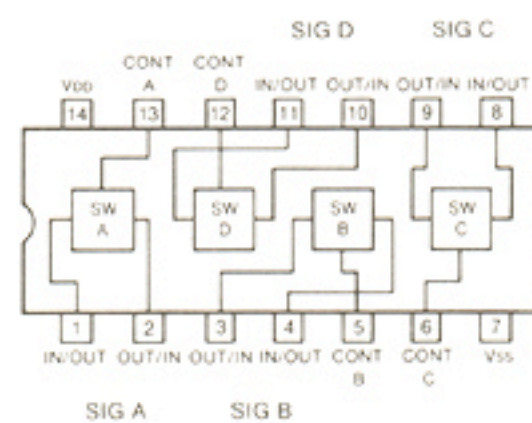


**TC4SU69 (INVERTER GATE)**  
IC408, IC409

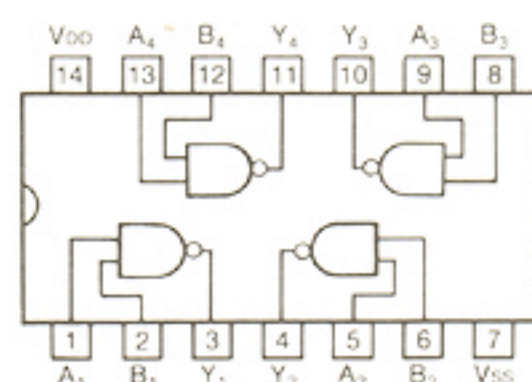


**NOTE:** The diagrams show the top view of each IC.

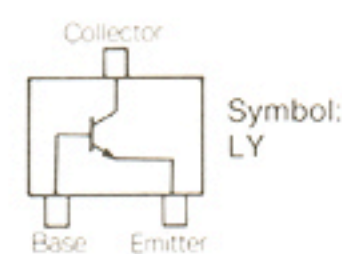
**μPD4066G (QUAD BILATERAL SWITCH)**  
IC403



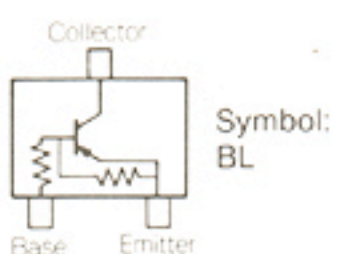
**μPD4011G (QUAD 2-INPUT NAND GATE)**  
IC404



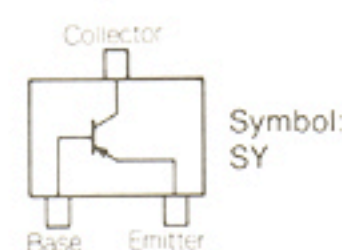
**2SC2712 Y**  
Q401, Q403, Q410  
Q415~Q417



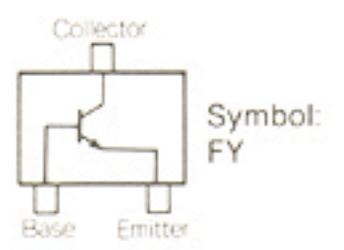
**2SA1341**  
Q407



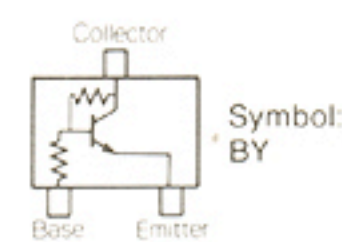
**2SA1162 Y**  
Q402, Q409



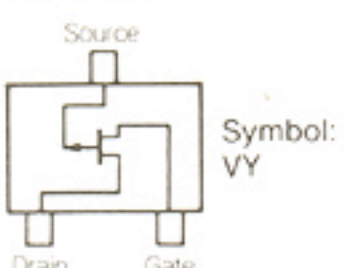
**2SC3661**  
Q412



**2SC3395**  
Q404~Q406

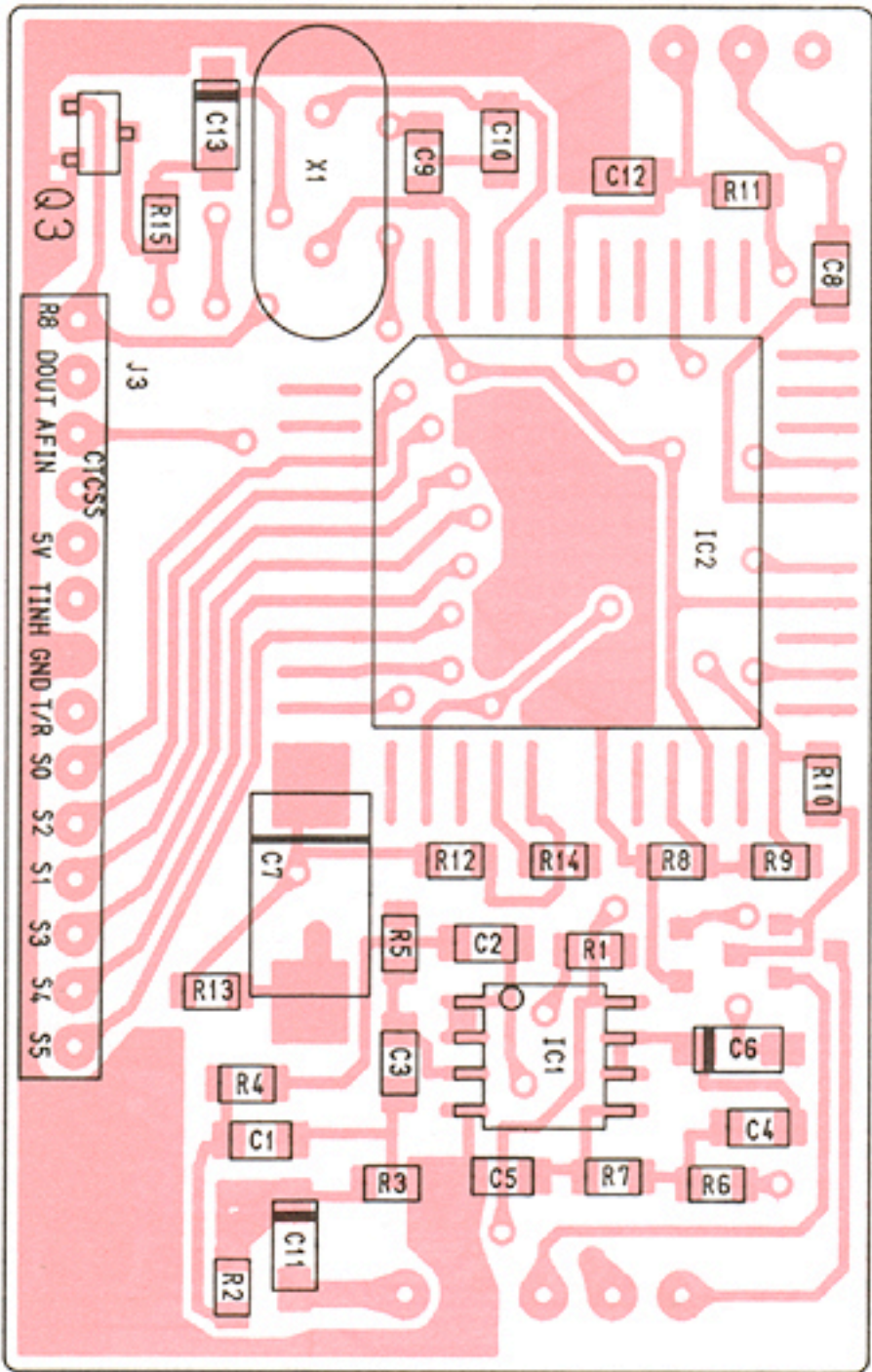


**2SJ106 Y**  
Q413, Q414



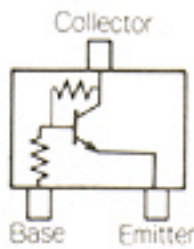


7-3 CTCSS UNIT

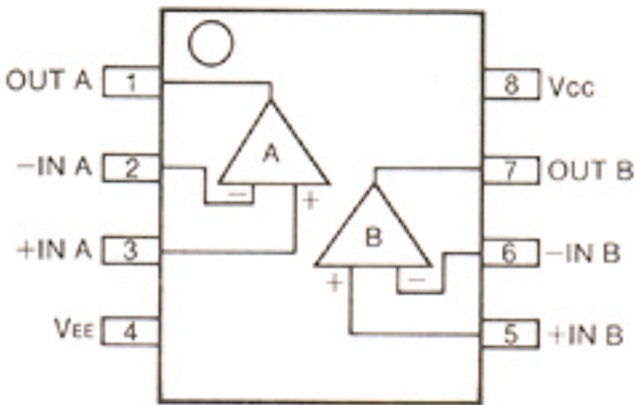


2SC3395  
Q603

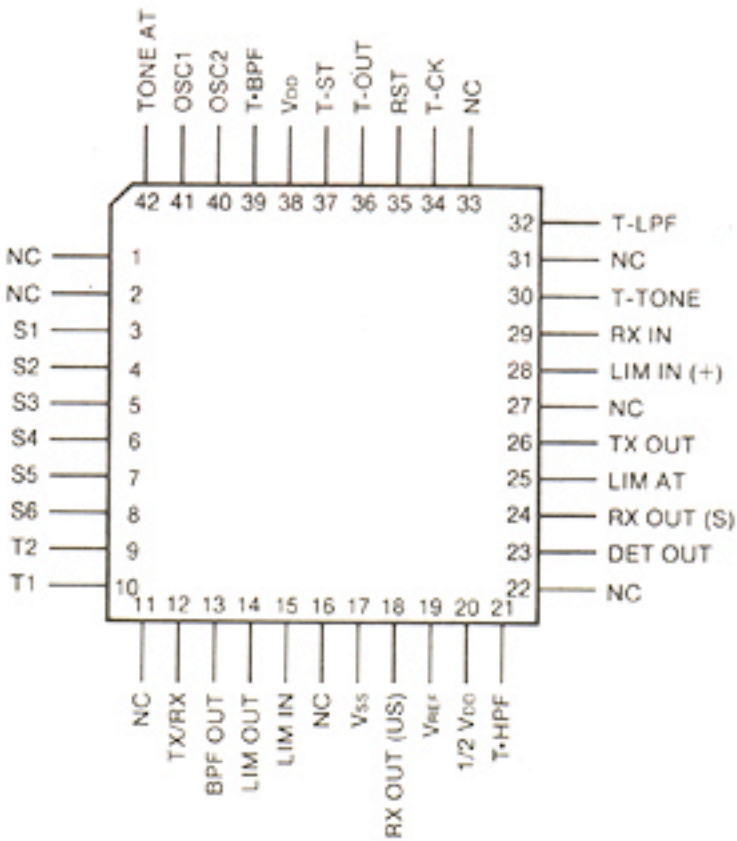
Symbol:  
BY



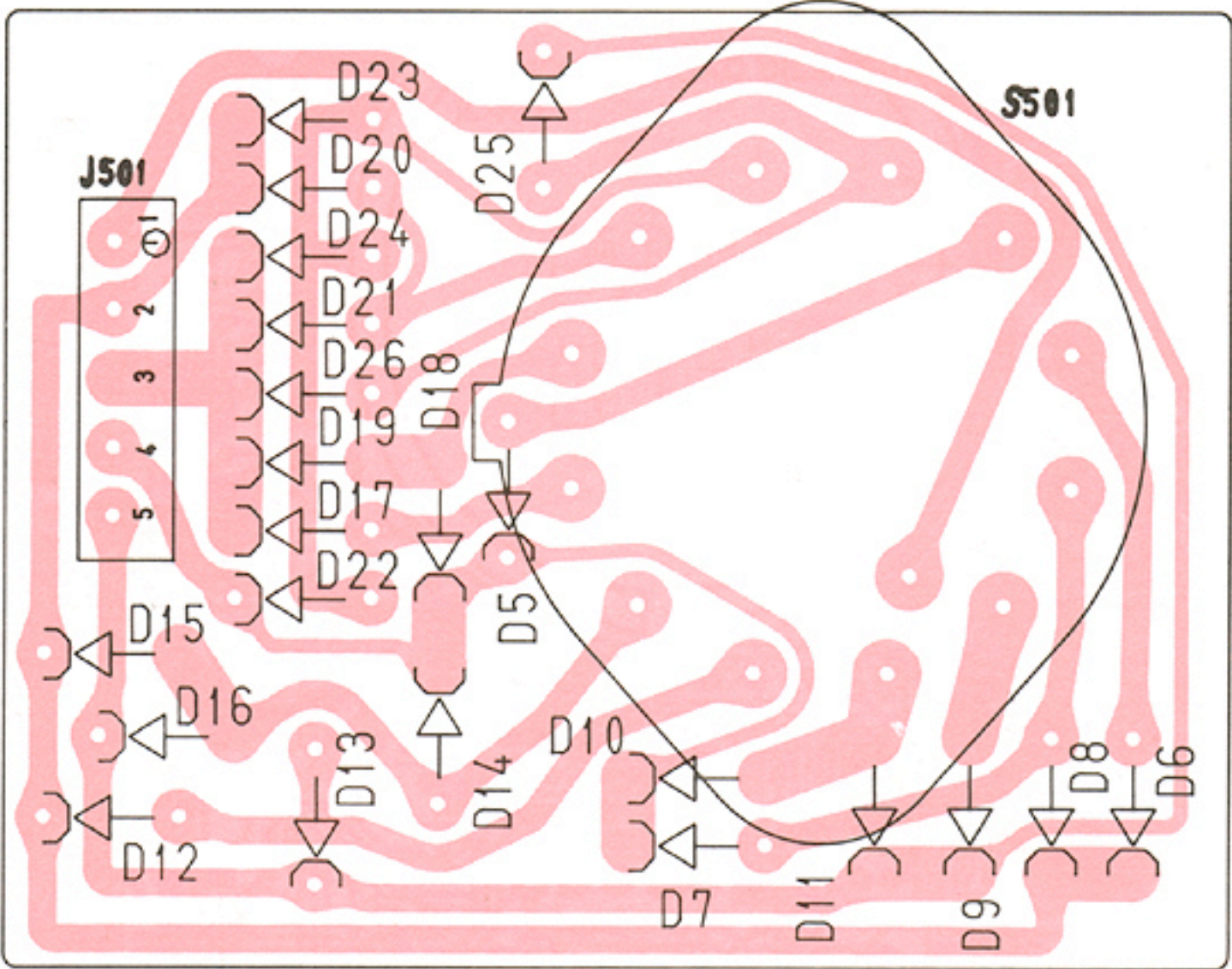
NJM4558M (DUAL NOISE LOW AMP)  
IC601  
(Top View)



MN6520 (CTCSS ENCODER/DECODER)  
IC602  
(Top View)



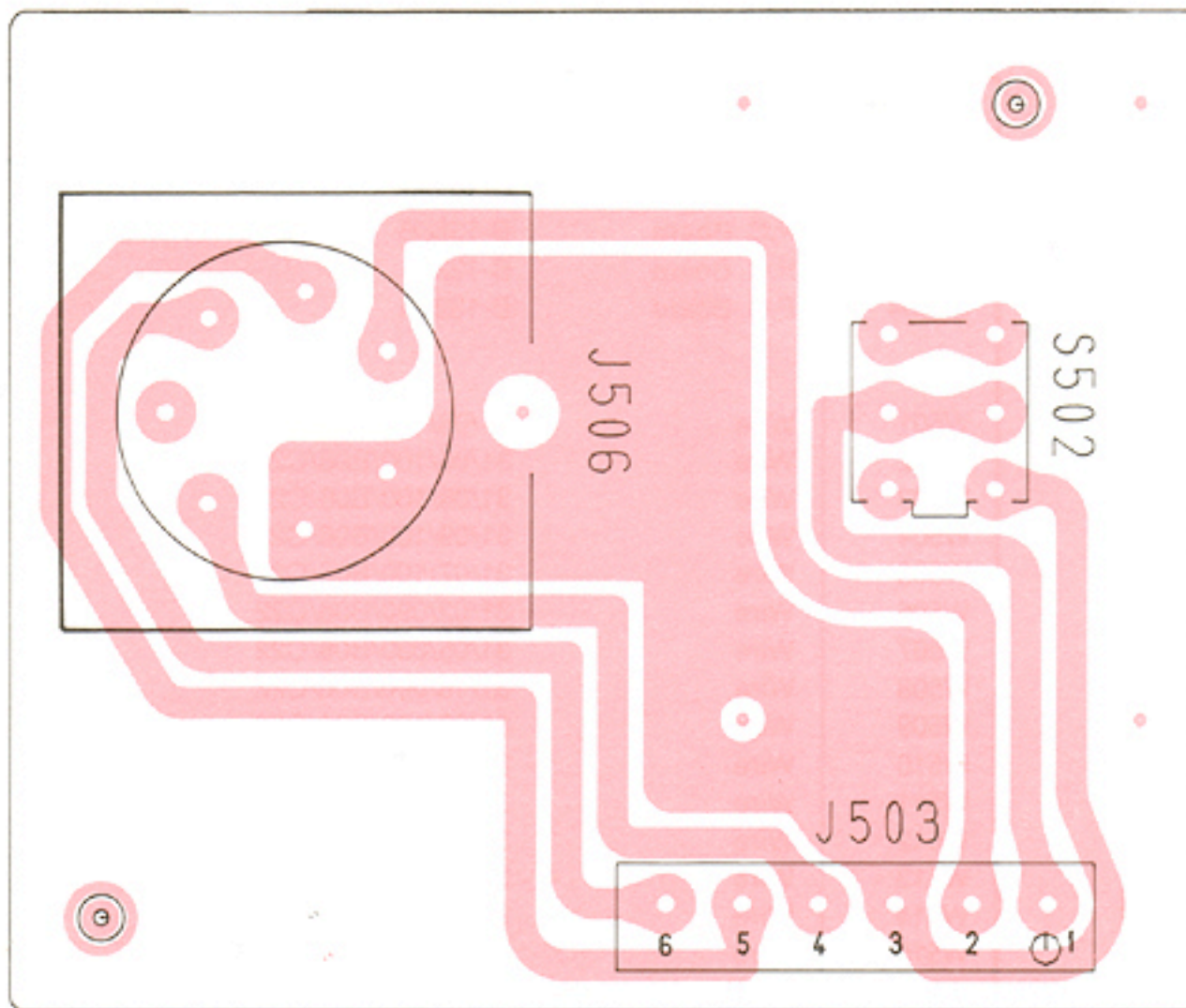
7-4 FRONT UNIT  
(CH)



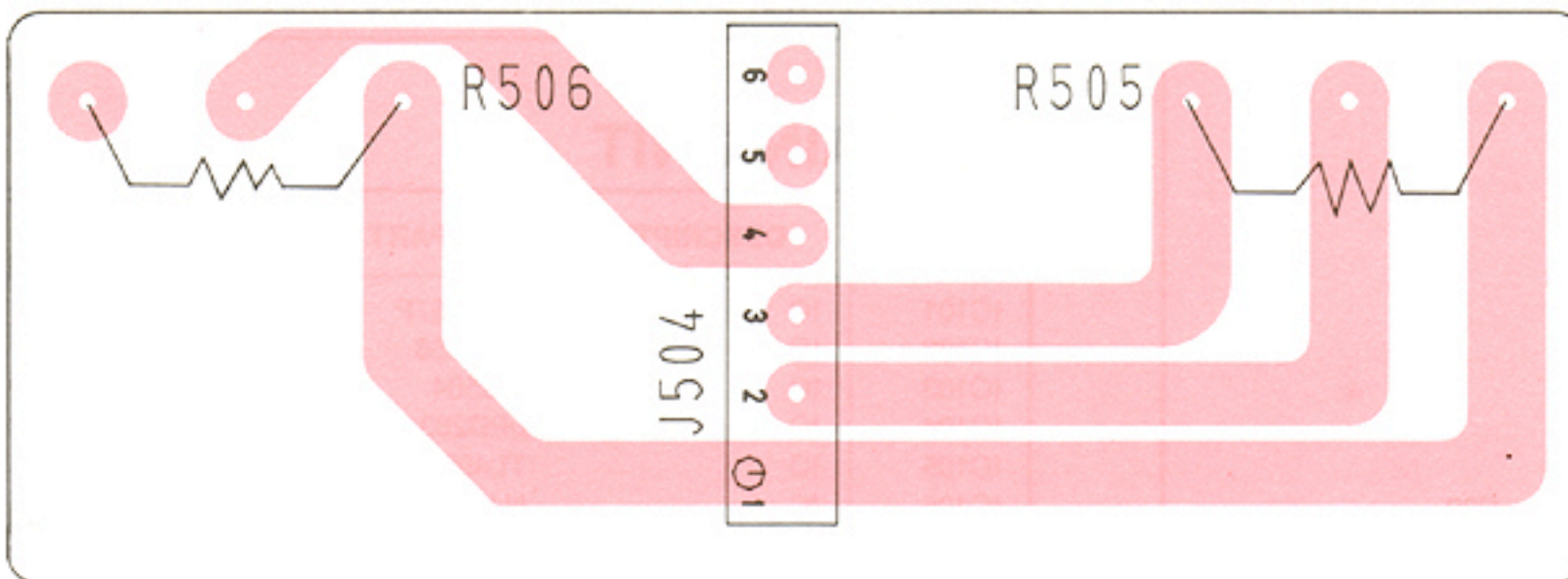


■ FRONT UNIT

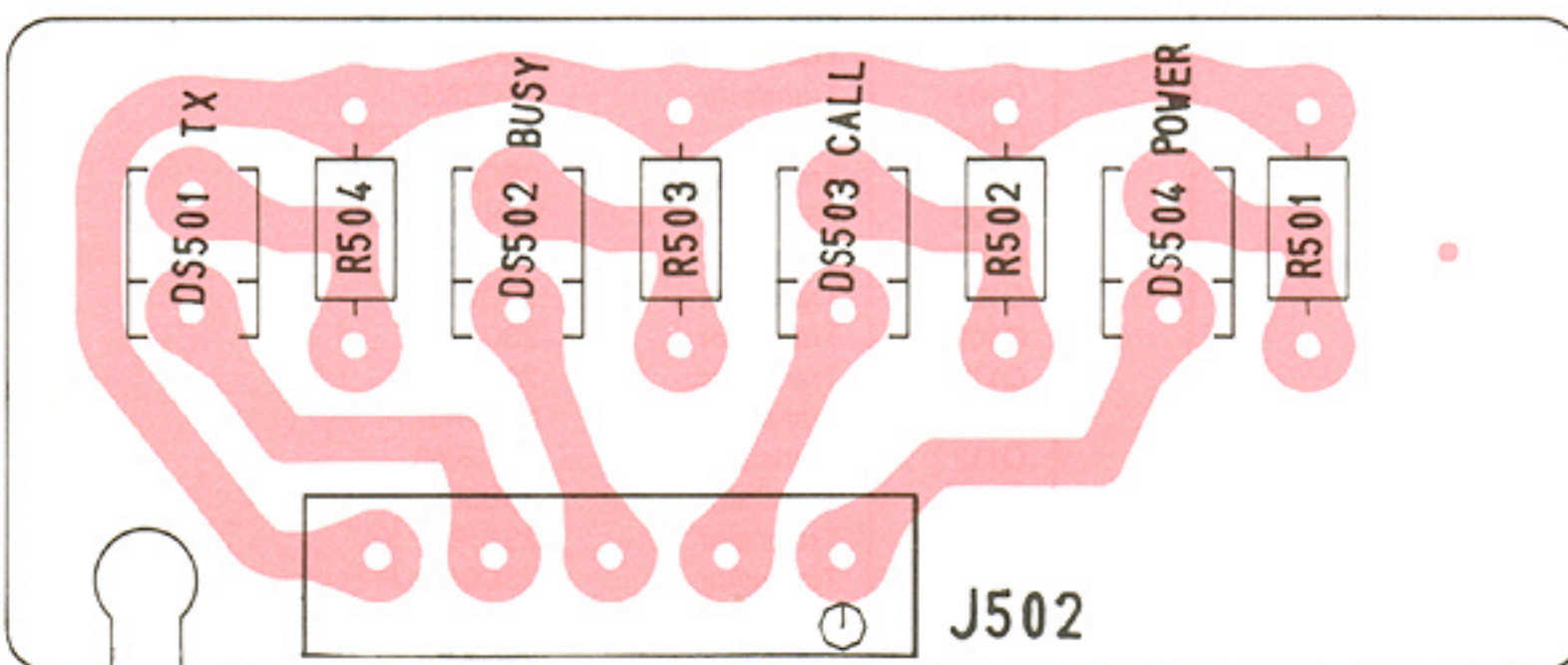
(MIC)



(VR)



(LED)



## SECTION 8 PARTS LIST

### 8-1 EF PARTS

REF. NO.	DESCRIPTION	PART NO.
C601	Ceramic	0.0047 50V
J1	Connector	HSJ0296
SP1	Speaker	66F09N-7
W1	Antenna Cable	OPC-103
W2	DC Cable	OPC-164A

### 8-2 FRONT UNIT

REF. NO.	DESCRIPTION	PART NO.
D505	Diode	1SS133
D506	Diode	1SS133
D507	Diode	1SS133
D508	Diode	1SS133
D509	Diode	1SS133
D510	Diode	1SS133
D511	Diode	1SS133
D512	Diode	1SS133
D513	Diode	1SS133
D514	Diode	1SS133
D515	Diode	1SS133
D516	Diode	1SS133
D517	Diode	1SS133
D518	Diode	1SS133
D519	Diode	1SS133
D520	Diode	1SS133
D521	Diode	1SS133
D522	Diode	1SS133
D523	Diode	1SS133
D524	Diode	1SS133
R501	Resistor	680Ω R20
R502	Resistor	680Ω R20
R503	Resistor	680Ω R20
R504	Resistor	680Ω R20
R505	Variable	RK1631111A72A
R506	Variable	RK1631110RJPA
J501	Connector	TLB05H-B1
J502	Connector	TLB05H-B1
J503	Connector	TLB06H-B1
J504	Connector	TLB06H-B1
J506	Connector	FM14RS-7SS
P501	Connector	EHR-5
P502	Connector	EHR-6
P503	Connector	EHR-4
P504	Connector	EHR-5
P505	Connector	EHR-3
DS501	LED	GL9PR2 (TX)
DS502	LED	GL9PG2 (BUSY)
DS503	LED	GL9HY2 (CALL)
DS504	LED	GL9PR2 (POWER)
S501	Switch	SRRM1C
S502	Switch	SPPH23079A

### [FRONT UNIT]

REF. NO.	DESCRIPTION	PART NO.
EP501	P.C. Board	B-1322B
EP502	P.C. Board	B-1386B
EP503	P.C. Board	B-1324
EP504	P.C. Board	B-1325A
W501	Wire	31/06/100/B06/C22
W502	Wire	31/05/100/B06/C22
W503	Wire	31/08/100/B06/C22
W504	Wire	31/09/100/B06/C22
W505	Wire	31/07/100/B06/C22
W506	Wire	31/02/090/B06/C22
W507	Wire	31/05/090/B06/C22
W508	Wire	31/15/090/B06/C22
W509	Wire	31/09/160/B06/C22
W510	Wire	31/14/090/B06/C22
W511	Wire	31/00/090/B06/C22
W512	Wire	31/06/140/B06/C22
W513	Wire	31/00/140/B06/C22
W514	Wire	31/08/140/B06/C22
W515	Wire	31/03/140/B06/C22
W516	Wire	31/12/160/B06/C22
W517	Wire	31/16/160/B06/C22
W518	Wire	31/08/160/B06/C22
W519	Shield cable	[ 51/99/160/B06A/C22A ]
W520		08
W521	Wire	31/02/200/B06/X04
W522	Wire	31/03/200/B06/X04

### 8-3 MAIN UNIT

REF. NO.	DESCRIPTION	PART NO.
IC101	IC	MC3357P
IC102	IC	MB3756
IC103	IC	MB504
IC104	IC	μPD2834C
IC105	IC	TL499A CP
IC106	IC	NJM7805
IC107	IC	μPC358C
IC108	IC	SC1044 (#01, #02, #06)
IC108	IC	M57741-L (#03)
IC108	IC	M57741-M (#04)
IC108	IC	M57741-H (#05)
Q101	FET	2SK241 GR
Q102	Transistor	2SC3355
Q103	Transistor	2SC3355
Q104	FET	2SK241 GR
Q105	Transistor	2SC2458 GR
Q106	FET	2SK241 GR
Q107	Transistor	2SC2026
Q108	Transistor	2SC2026
Q109	Transistor	2SC2026
Q110	Transistor	2SC2026
Q111	Transistor	2SC2407
Q112	Transistor	2SC2053
Q113	Transistor	2SB561 C
Q114	Transistor	2SB596 Y
Q115	Transistor	2SC945 P
Q116	Transistor	2SC945 P
Q117	Transistor	2SC2458 GR
Q118	Transistor	2SA1048 GR
Q119	Transistor	2SC2458 GR
Q120	Transistor	2SK184 Y
Q121	Transistor	2SC2458 GR
Q122	Transistor	2SC2458 GR

## [MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
D101	Varicap	1SV153
D102	Varicap	1SV153
D103	Varicap	1SV153
D104	Varicap	1SV153
D105	Varicap	1SV153
D106	Varicap	1SV153
D107	Varicap	1SV153
D108	Varicap	1SV153
D109	Varicap	1SV153
D110	Varicap	1SV153
D111	Diode	1SS99
D113	Zener	RD6.2E B2
D114	Diode	1SS133
D115	Diode	1S953
D116	Diode	1S953
D117	Diode	1SS133
D118	Diode	1SS211
D119	Diode	1SS211
D120	Diode	1SS216
D121	Varicap	1SV50E (1)
D122	Varicap	1SV50E (1)
D123	Diode	1SS216
D124	Diode	1SS216
D125	Zener	RD4.7E B3
D126	Diode	1S953
D127	Diode	1SS211
D128	Diode	MI308
D130	Diode	1SS97
D131	Diode	1SS133
D132	Diode	MI308
D133	Diode	MI308
D134	Diode	1S953
D135	Diode	15CD11
D136	Varicap	1SV50E (1)
D137	Varicap	1SS133
D138	Varicap	1SS133
FI101	Crystal	21M7B2 (#01, #06)
FI101	Crystal	21M15B3 (#02, #03, #04, #05)
FI102	Ceramic	CFW455HT (#01, #06)
FI102	Ceramic	CFW455E (#02, #03, #04, #05)
X101	Crystal	CR70
X102	Discriminator	CDB455C7A
X103	Crystal	CR85 (#01, #06)
X103	Crystal	CR164 (#02, #03, #04, #05)
L101	Coil	LS-315
L102	Coil	LS-315
L103	Coil	LS-296
L104	Coil	LS-295
L105	Coil	LS-295
L106	Coil	LR-116
L107	Coil	LS-304
L108	Coil	LS-298
L109	Coil	LS-297
L110	Coil	LAL03NA 2R2
L111	Coil	LB-216
L112	Coil	LAL03NA 3R3
L113	Coil	LAL03NA 4R7
L114	Coil	LAL03NA 4R7
L115	Coil	LAL03NA 4R7
L116	Coil	LA-237
L117	Coil	LR-116
L118	Coil	LA-237
L119	Coil	LA-237
L120	Coil	LA-236
L121	Coil	LA-244
L122	Coil	LA-233
L123	Coil	LA-235
L124	Coil	LA-254
L125	Coil	LA-254

## [MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
L126	Coil	LW-19
L127	Coil	LA242 (#01, #02, #06)
L127	Coil	LA253 (#03, #04, #05)
L128	Coil	LA253 (#01, #02, #06)
L128	Coil	LA243 (#03, #04, #05)
L129	Coil	LA-253
L130	Coil	LW-16
L131	Coil	LW-12A
L132	Coil	LAL03NA 681K
L133	Coil	LAL03NA 101K
L134	Coil	FL5H 101K
L135	Coil	LAL03NA 101K
L136	Coil	LA-244
L137	Coil	LA-235
L138	Coil	LA-235
R101	Resistor	150kΩ ELR20
R102	Resistor	150kΩ ELR20
R103	Resistor	18Ω ELR20
R104	Resistor	3.3kΩ ELR20
R105	Resistor	100Ω R20
R106	Resistor	150kΩ ELR20
R107	Resistor	150kΩ ELR20
R108	Resistor	150kΩ R20
R109	Resistor	100Ω R20
R110	Resistor	22kΩ R20
R111	Resistor	330Ω ELR20
R112	Resistor	330Ω ELR20
R113	Resistor	1kΩ ELR20
R114	Resistor	22Ω ELR20
R115	Resistor	22Ω ELR20
R116	Resistor	10kΩ R20
R118	Resistor	10kΩ R20
R119	Resistor	470kΩ ELR20
R120	Resistor	100Ω ELR20
R121	Resistor	100Ω R25
R122	Resistor	10kΩ R20
R123	Resistor	820kΩ ELR20
R124	Resistor	47kΩ ELR20
R125	Resistor	2.2kΩ ELR20 (#01, #06)
R125	Resistor	1.5kΩ ELR20 (#02, #03, #04, #05)
R126	Resistor	2.2kΩ ELR20 (#01, #06)
R126	Resistor	1.5kΩ ELR20 (#02, #03, #04, #05)
R127	Resistor	47kΩ ELR20
R128	Resistor	1.5kΩ ELR20
R129	Resistor	2.2kΩ ELR20
R130	Resistor	22kΩ ELR20
R131	Thermistor	33D28
R132	Resistor	470kΩ ELR20 (#01, #06)
R132	Resistor	330kΩ ELR20 (#02, #03, #04, #05)
R133	Resistor	2.2kΩ ELR20
R134	Resistor	68kΩ ELR20 (#01, #06)
R134	Resistor	22kΩ ELR20 (#02, #03, #04, #05)
R135	Resistor	47kΩ ELR20
R136	Resistor	100kΩ ELR20
R137	Resistor	330Ω ELR20
R138	Resistor	5.6kΩ ELR20
R139	Resistor	4.7kΩ ELR20
R140	Resistor	100Ω R20
R141	Resistor	100Ω ELR20
R142	Resistor	47Ω R20
R143	Resistor	330Ω ELR20
R144	Resistor	330Ω ELR20
R145	Resistor	22Ω R20
R146	Resistor	2.2kΩ ELR20
R147	Resistor	3.3kΩ R20
R148	Resistor	220Ω ELR20
R149	Resistor	1kΩ ELR20
R150	Resistor	68Ω ELR20
R151	Resistor	68Ω R20
R152	Resistor	680Ω R20
R153	Resistor	3.3kΩ R20
R154	Resistor	2.2kΩ R20
R155	Resistor	220Ω ELR20



[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
R156	Resistor	2.2kΩ ELR20
R157	Resistor	2.2kΩ ELR20
R158	Resistor	2.2kΩ ELR20
R159	Resistor	2.2kΩ ELR20
R160	Resistor	100Ω ELR20
R161	Resistor	100Ω ELR20
R162	Resistor	2.2kΩ ELR20
R163	Resistor	15kΩ ELR20
R164	Resistor	100Ω R20
R165	Resistor	100Ω ELR20
R166	Resistor	1kΩ ELR20
R167	Resistor	100Ω ELR20
R168	Resistor	1kΩ ELR20
R169	Resistor	10Ω ELR25
R170	Resistor	15Ω R50
R171	Resistor	4.7kΩ R20
R172	Resistor	100Ω ELR20
R173	Resistor	10kΩ ELR20
R174	Resistor	100kΩ R20
R175	Resistor	27kΩ ELR20
R176	Resistor	100kΩ ELR20
R177	Resistor	15kΩ ELR20
R178	Resistor	33kΩ R20
R179	Trimmer	RH0651C15JUA 100kΩ
R180	Resistor	33kΩ ELR20
R181	Resistor	15kΩ ELR20
R182	Thermistor	33D28
R183	Resistor	10kΩ ELR20
R184	Thermistor	33D28
R185	Resistor	2.2kΩ ELR20
R186	Resistor	6.8kΩ ELR20
R187	Resistor	100kΩ ELR20
R188	Resistor	100kΩ ELR20
R189	Resistor	2.2kΩ ELR20
R190	Resistor	100Ω ELR20
R191	Resistor	1kΩ ELR20
R192	Resistor	680Ω R20
R193	Resistor	82kΩ ELR20
R194	Resistor	4.7kΩ ELR20
R195	Resistor	120kΩ ELR20
R196	Resistor	39kΩ ELR20
R197	Resistor	33kΩ ELR20
R198	Resistor	470kΩ ELR20
R199	Resistor	82kΩ ELR20
R200	Resistor	10kΩ ELR20
R201	Resistor	33kΩ ELR20
R202	Resistor	82kΩ ELR20
R203	Resistor	1kΩ ELR20
R204	Resistor	1.8kΩ ELR20
R205	Resistor	22kΩ ELR20
R206	Resistor	4.7kΩ ELR20
R207	Resistor	100kΩ ELR20
R208	Resistor	47kΩ ELR20
R209	Resistor	10kΩ R20
R210	Resistor	2.2kΩ ELR20
R211	Resistor	12kΩ ELR20
R212	Resistor	5.6kΩ ELR20
R213	Resistor	100Ω R20
R214	Resistor	1.2kΩ ELR20
R215	Resistor	100Ω R20
R216	Resistor	100Ω ELR20
R217	Resistor	10kΩ R20
R218	Resistor	220Ω R20
R219	Resistor	470Ω R20 (#01, #02, #06)
R220	Resistor	1kΩ ELR20
C101	Ceramic	0.001μF 50V
C102	Ceramic	3pF 50V
C103	Ceramic	0.5μF 50V
C104	Ceramic	0.001μF 50V
C105	Ceramic	0.001μF 50V
C106	Ceramic	470pF 50V
C108	Ceramic	2pF 50V
C109	Ceramic	2pF 50V

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
C110	Ceramic	1pF 50V
C111	Ceramic	0.001μF 50V
C113	Ceramic	0.001μF 50V
C114	Ceramic	0.001μF 50V
C115	Ceramic	0.001μF 50V
C116	Ceramic	3pF 50V
C117	Ceramic	0.001μF 50V
C118	Ceramic	0.001μF 50V
C119	Ceramic	0.001μF 50V
C120	Ceramic	0.0047μF 50V
C121	Ceramic	15pF 50V (#01, #06)
C121	Ceramic	7pF 50V (#02, #03, #04, #05)
C122	Ceramic	82pF 50V
C123	Ceramic	68pF 50V
C124	Ceramic	0.001μF 50V
C125	Barrier Layer	0.0047μF 25V
C126	Ceramic	0.001μF 50V
C127	Ceramic	120pF 50V
C128	Ceramic	68pF 50V
C129	Barrier Layer	0.1μF 16V
C130	Ceramic	82pF 50V
C131	Tantalum	0.1μF 35V DN
C132	Ceramic	0.001μF 50V
C133	Electrolytic	10μF 16V MS7
C134	Electrolytic	0.1μF 50V MS7
C135	Barrier Layer	0.1μF 16V
C136	Mylar	0.001μF 50V
C137	Mylar	0.022μF 50V (#01, #06)
C137	Mylar	0.001μF 50V (#02, #03, #04, #05)
C138	Ceramic	24pF 50V (#01, #06)
C138	Ceramic	33pF 50V (#02, #03, #04, #05)
C139	Mylar	0.022μF 50V (#01, #06)
C139	Mylar	0.001μF 500V (#02, #03, #04, #05)
C140	Electrolytic	0.47μF 50V MS7
C141	Electrolytic	2.2μF 50V MS7
C142	Mylar	0.022μF 50V
C143	Electrolytic	100μF 10V
C144	Ceramic	470pF 50V
C145	Trimmer	20pF CV38D2001
C146	Ceramic	30pF 50V
C147	Ceramic	0.001μF 50V
C148	Ceramic	470pF 50V
C150	Ceramic	30pF 50V
C151	Ceramic	22pF 50V
C152	Ceramic	3pF 50V UJ
C153	Ceramic	0.5pF 50V
C154	Ceramic	3pF 50V UJ
C155	Ceramic	470pF 50V
C156	Ceramic	0.001μF 50V
C157	Ceramic	0.001μF 50V
C158	Ceramic	22pF 50V
C159	Ceramic	0.001μF 50V
C160	Ceramic	0.001μF 50V
C161	Ceramic	470pF 50V
C162	Ceramic	0.001μF 50V
C163	Ceramic	18pF 50V
C164	Ceramic	0.001μF 50V
C165	Ceramic	0.001μF 50V
C166	Ceramic	0.001μF 50V
C167	Ceramic	0.001μF 50V
C168	Ceramic	18pF 50V
C169	Ceramic	18pF 50V
C170	Ceramic	0.001μF 50V
C171	Ceramic	0.001μF 50V
C172	Ceramic	8pF 50V
C173	Ceramic	0.001μF 50V
C174	Ceramic	0.001μF 50V
C175	Ceramic	470pF 50V
C176	Ceramic	15pF 50V
C178	Ceramic	0.001μF 50V
C179	Ceramic	470pF 50V
C180	Ceramic	0.001μF 50V
C181	Ceramic	8pF 50V
C182	Ceramic	4pF 50V (#01, #02, #03, #06)
C183	Ceramic	0.001μF 50V

# [MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
C184	Ceramic	0.001μF 50V
C186	Ceramic	470pF 50V
C187	Ceramic	470pF 50V
C188	Ceramic	0.001μF 50V
C189	Ceramic	470pF 50V
C190	Ceramic	0.001μF 50V
C191	Ceramic	0.001μF 50V
C192	Ceramic	10pF 500V (#01, #02, #06)
C192	Ceramic	8pF 500V (#03, #04, #05)
C193	Ceramic	470pF 50V
C194	Ceramic	0.001μF 50V
C195	Ceramic	0.001μF 50V
C196	Ceramic	470pF 50V
C197	Ceramic	0.001μF 50V
C198	Ceramic	470pF 50V
C199	Ceramic	0.001μF 50V
C200	Barrier Layer	0.1μF 16V
C201	Ceramic	0.5μF 500V
C202	Ceramic	470pF 50V
C203	Ceramic	4pF 500V
C204	Ceramic	0.001μF 500V B
C205	Ceramic	39pF 500V
C206	Ceramic	20pF 500V
C207	Ceramic	18pF 500V (#01, #02, #06)
C207	Ceramic	5pF 500V (#03)
C207	Ceramic	3pF 500V (#04, #05)
C208	Ceramic	20pF 500V(#01,#02,#04,#05,#06)
C208	Ceramic	24pF 500V (#03)
C209	Ceramic	5pF 500V (#01, #02, #06)
C209	Ceramic	8pF 500V (#03, #04, #05)
C210	Ceramic	24pF 500V
C211	Ceramic	1pF 500V
C212	Ceramic	5pF 500V
C213	Ceramic	6pF 500V
C214	Ceramic	0.001μF 50V
C215	Ceramic	0.001μF 50V
C217	Barrier Layer	0.01μF 25V
C218	Barrier Layer	0.1μF 16V
C219	Barrier Layer	0.1μF 16V
C220	Electrolytic	470μF 16V SS
C221	Ceramic	0.0047μF 50V
C222	Electrolytic	470μF 16V SS
C223	Electrolytic	470μF 16V SS
C224	Ceramic	0.001μF 50V
C225	Barrier Layer	0.1μF 16V
C226	Electrolytic	4.7μF 25V MS7
C228	Barrier Layer	0.1μF 16V
C229	Barrier Layer	0.1μF 16V
C230	Ceramic	4pF 50V CH
C231	Ceramic	0.001μF 50V
C232	Ceramic	100pF 50V
C233	Ceramic	220pF 50V
C234	Ceramic	0.001μF 50V
C236	Barrier Layer	0.01μF 25V
C237	Ceramic	27pF 50V CH
C238	Trimmer	20pF CV38D2001
C239	Ceramic	0.001μF 50V
C240	Ceramic	0.001μF 50V
C241	Electrolytic	0.1μF 50V MS7
C242	Electrolytic	47μF 25V
C243	Electrolytic	22μF 25V
C244	Ceramic	0.001μF 50V
C245	Electrolytic	22μF 6.3V MS5
C246	Electrolytic	100μF 10V
C247	Ceramic	100pF 50V
C248	Barrier Layer	0.047μF 25V
C249	Tantalum	4.7μF 35V DN
C250	Barrier Layer	0.01μF 25V
C251	Tantalum	0.1μF 35V DN
C252	Electrolytic	0.1μF 50V MS7
C253	Electrolytic	47μF 16V
C254	Ceramic	0.001μF 50V
C255	Electrolytic	2.2μF 50V MS5
C256	Ceramic	0.001μ 50V
C257	Ceramic	10pF 50V (#01, #02, #03, #06)

# [MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
C258	Ceramic	0.001μF 50V
C260	Cylinder	15pF UP125SL 150M
C261	Ceramic	33pF 50V
C262	Ceramic	22pF 50V
C263	Ceramic	22pF 50V
C265	Ceramic	0.001μF 50V
C266	Ceramic	0.001μF 50V
C267	Ceramic	0.001μF 50V
C268	Ceramic	0.5pF 50V
C269	Ceramic	0.5pF 50V
C270	Ceramic	0.5pF 50V
C271	Ceramic	0.001μF 50V
C272	Barrier Layer	0.1μF 16V
C273	Electrolytic	10μF 16V MS7
C274	Ceramic	22pF 500V
C276	Electrolytic	1μF 50V MS5
C277	Ceramic	0.001μF 50V
C278	Barrier Layer	0.1μF 16V
C279	Tantalum	0.1μF 35V DN
C280	Ceramic	0.001μF 50V
C281	Ceramic	0.001μF 50V
C282	Electrolytic	47μF 6.3V MS7
C283	Barrier Layer	0.01μF 25V
C284	Tantalum	4.7μF 16V DN
C285	Mylar	0.022μF 50V
C286	Ceramic	470pF 50V
C288	Ceramic	0.001μF 50V
C289	Ceramic	0.001μF 50V
C290	Ceramic	0.001μF 50V
C291	Ceramic	0.001μF 50V
C293	Ceramic	0.0047μF 50V
C294	Ceramic	0.001μF 50V
C295	Ceramic	0.0047μF 50V
C296	Ceramic	0.001μF 50V
C297	Ceramic	0.0047μF 50V
C298	Ceramic	0.001μF 50V
C299	Ceramic	3pF 500V (#01, #02, #06)
C299	Ceramic	5pF 500V (#03)
J101	Connector	B03B-EH-S
J102	Connector	WH5D-1
J103	Connector	WH8D-1
J104	Connector	WH10D-1
EP101	P.C. Board	B-1628A
EP103	Ferrite Bead	DL2-OP2.6-3-1.2H
EP104	Ferrite Bead	DL2-OP2.6-3-1.2H
W101	Ribbon Cable	2468 AWG26 VW-1 E43172 (10)
W102	Ribbon Cable	2468 AWG26 VW-1 E43172 (5)
W103	Ribbon Cable	2468 AWG26 VW-1 E43172 (5)
W104	Jumper	JPW-02A
W105	Jumper	JPW-02A
W106	Jumper	JPW-02A
W107	Jumper	JPW-02A
W108	Jumper	JPW-02A
W109	Jumper	JPW-02A

## 8-4 LOGIC UNIT

REF. NO.	DESCRIPTION	PART NO.
IC401	IC	μPD78C06AG-570-12
IC402	IC	μPD446G
IC403	IC	μPD4066BG
IC404	IC	μPD4011BG
IC405	IC	NJM4558M
IC406	IC	μPC2002H
IC407	IC	NJM4558M
IC408	IC	TC4SU69F
IC409	IC	TC4SU69F

[LOGIC UNIT]

REF. NO.	DESCRIPTION	PART NO.
Q401	Transistor	2SC2712 Y
Q402	Transistor	2SA1162 Y
Q403	Transistor	2SC2712 Y
Q404	Transistor	2SC3395
Q405	Transistor	2SC3395
Q406	Transistor	2SC3395
Q407	Transistor	2SA1341
Q409	Transistor	2SA1162 Y
Q410	Transistor	2SC2712 Y
Q412	Transistor	2SC3661
Q413	FET	2SJ106 Y
Q414	FET	2SJ106 Y
Q415	Transistor	2SC2712 Y
Q416	Transistor	2SC2712 Y
Q417	Transistor	2SC2712 Y
D401	Diode	1SS187
D402	Diode	1SS181
D403	Diode	1SS184
D404	Zener	RD6.2M B2
D405	Diode	1SS181
D406	Diode	1SS181
D407	Diode	1SS196
D408	Diode	1SS184
D409	Diode	1SS187
D410	Zener	RD5.1M B2
D411	Diode	1SS187
D412	Diode	1SS193
D413	Diode	1SS184
D414	Diode	1SS190
D415	Diode	1SS133
D416	Diode	1SS187
D417	Diode	1SS193
X401	Crystal	FAGNKD
R401	Resistor	47kΩ MCR10
R402	Resistor	1MΩ MCR10
R403	Resistor	47kΩ MCR10
R404	Resistor	47kΩ MCR10
R405	Resistor	47kΩ MCR10
R406	Resistor	47kΩ MCR10
R407	Resistor	47kΩ MCR10
R408	Resistor	470Ω MCR10
R409	Resistor	47kΩ MCR10
R410	Resistor	47kΩ MCR10
R411	Resistor	47kΩ MCR10
R412	Resistor	47kΩ MCR10
R413	Resistor	47kΩ MCR10
R414	Resistor	10kΩ MCR10
R415	Resistor	10kΩ MCR10
R416	Resistor	10kΩ MCR10
R417	Resistor	10kΩ MCR10
R418	Resistor	18kΩ MCR10
R419	Resistor	470kΩ MCR10
R420	Resistor	1MΩ MCR10
R423	Resistor	22kΩ MCR10
R424	Resistor	120kΩ MCR10
R425	Resistor	180kΩ MCR10
R426	Resistor	15kΩ MCR10
R427	Resistor	1kΩ MCR10
R428	Resistor	47kΩ MCR10
R430	Resistor	4.7kΩ MCR10
R431	Resistor	330kΩ MCR10
R432	Resistor	3.9kΩ MCR10
R433	Resistor	82kΩ MCR10
R434	Resistor	4.7kΩ MCR10
R435	Resistor	560Ω MCR10
R436	Resistor	100Ω MCR10
R437	Trimmer	10kΩ RH0651C14J2WA
R438	Resistor	47Ω MCR10
R439	Resistor	1.5kΩ MCR10

[LOGIC UNIT]

REF. NO.	DESCRIPTION	PART NO.
R440	Resistor	100kΩ MCR10
R441	Trimmer	470kΩ RH0651CS5J10A
R442	Resistor	470kΩ MCR10
R443	Resistor	6.8kΩ MCR10
R445	Resistor	12kΩ MCR10
R446	Resistor	12kΩ MCR10
R447	Resistor	47Ω MCR10
R449	Resistor	33kΩ MCR10
R450	Trimmer	470kΩ RH0651CS5J10A
R451	Trimmer	10kΩ RH0651C14J2WA
R452	Resistor	4.7kΩ MCR10
R453	Resistor	100kΩ MCR10
R454	Resistor	1Ω MCR10
R455	Resistor	220Ω MCR10
R456	Resistor	2.2Ω MCR10
R457	Resistor	100kΩ MCR10
R458	Resistor	22kΩ MCR10
R459	Resistor	33kΩ MCR10
R460	Resistor	1MΩ MCR10
R461	Resistor	4.7kΩ MCR10
R462	Resistor	270kΩ MCR10
R463	Resistor	220kΩ MCR10
R464	Resistor	12kΩ MCR10
R465	Resistor	1.2kΩ MCR10
R466	Resistor	6.8kΩ MCR10
R467	Resistor	2.2MΩ MCR10
R468	Resistor	470kΩ MCR10
R469	Resistor	33kΩ MCR10
R470	Resistor	180kΩ MCR10
R471	Resistor	220kΩ MCR10
R472	Resistor	22kΩ MCR10
R473	Resistor	27kΩ MCR10
R474	Resistor	100Ω MCR10
R475	Resistor	100kΩ MCR10
R477	Resistor	27kΩ MCR10
R478	Resistor	8.2kΩ MCR10
R479	Resistor	18kΩ MCR10
R480	Resistor	12kΩ MCR10
R481	Resistor	1kΩ MCR10
R482	Resistor	10kΩ MCR10
R483	Resistor	12kΩ MCR10
R484	Resistor	1kΩ MCR10
R485	Resistor	270kΩ MCR10
R486	Resistor	47kΩ MCR10
R487	Resistor	470Ω MCR10
R488	Resistor	470kΩ MCR10
R489	Resistor	3.9kΩ MCR10
R490	Resistor	330kΩ MCR10
R491	Resistor	68kΩ MCR10
R492	Resistor	820Ω MCR10
R493	Resistor	56kΩ MCR10
C401	Ceramic	0.1μF GRM40 F
C402	Ceramic	18pF GRM40
C403	Ceramic	18pF GRM40
C404	Ceramic	0.001μF GRM40
C405	Ceramic	0.01μF GRM40 F
C406	Tantalum	0.47μF 35V DN
C408	Tantalum	0.47μF 35V DN
C409	Electrolytic	4.7μF 25V MS7
C410	Ceramic	0.0033μF GRM40
C411	Electrolytic	4.7μF 25V
C412	Electrolytic	0.47μF 50V
C413	Electrolytic	22μF 16V MS7
C414	Electrolytic	0.47μF 50V MS7
C415	Mylar	0.01μF 50V F
C416	Ceramic	0.001μF GRM40
C417	Electrolytic	22μF 16V MS7
C418	Mylar	0.033μF 50V
C419	Ceramic	470pF GRM40
C420	Mylar	0.001μF 50V
C421	Ceramic	0.001μF GRM40
C422	Ceramic	0.001μF GRM40
C423	Electrolytic	4.7μF 25V MS7

# [LOGIC UNIT]

REF. NO.	DESCRIPTION	PART NO.
C424	Barrier Layer	UAT06X153K
C425	Electrolytic	4.7μF 50V
C426	Ceramic	0.1μF GRM40 F
C427	Electrolytic	470μF 16V SS
C428	Electrolytic	470μF 16V MS16
C429	Electrolytic	470μF 6.3V SS
C430	Ceramic	0.01μF GRM40 F
C432	Electrolytic	0.33μF 50V MS7
C433	Electrolytic	4.7μF 25V
C434	Ceramic	0.01μF GRM40 F
C435	Electrolytic	0.47μF 50V
C436	Ceramic	0.047μF GRM40
C437	Ceramic	0.01μF GRM40 F
C438	Ceramic	0.01μF GRM40 F
C439	Electrolytic	0.47μF 50V MS7
C440	Ceramic	0.0068μF GRM40
C441	Ceramic	0.01μF GRM40 F
C442	Ceramic	0.01μF GRM40 F
C443	Electrolytic	10μF 16V
C444	Ceramic	0.01μF GRM40 F
C445	Ceramic	0.01μF GRM40 F
C446	Ceramic	0.0022μF GRM40
C447	Electrolytic	0.47μF 50V
C448	Ceramic	47pF GRM40
C449	Ceramic	47pF GRM40
C450	Ceramic	47pF GRM40
C451	Ceramic	0.001μF GRM40
C452	Ceramic	47pF GRM40
C453	Ceramic	47pF GRM40
C454	Ceramic	0.1μF GRM40 F
C455	Ceramic	0.001μF GRM40
C456	Tantalum	4.7μF SVB0J475M
C457	Electrolytic	1μF 50V MS7
C458	Electrolytic	4.7μF 25V MS7
C459	Tantalum	0.1μF 35V DN
C460	Ceramic	0.001μF GRM40
C461	Tantalum	0.33μF 35V DN
C462	Electrolytic	1μF 50V
C463	Electrolytic	1μF 50V
C464	Electrolytic	22μF 16V MS7
CP401	Check Point	RT-01T-1.0B
J401	Connector	B05B-EH-S
J402	Connector	B06B-EH-S
J403	Connector	B03B-EH-S
J404	Connector	B03B-EH-S
J405	Connector	B05B-EH-S
J407	Connector	B04B-EH-S
J408	Connector	5512-14A
J409	Connector	B08B-EH-S
J412	Connector	HBRB5S-1J
J413	Connector	HBRB10S-1J
J414	Connector	HBRB5S-1J
S401	Switch	SKHLAB064A
BT401	Lithium Battery	BR2325-1HC
EP401	P.C. Board	B-1560B

# 8-5 CTCSS UNIT

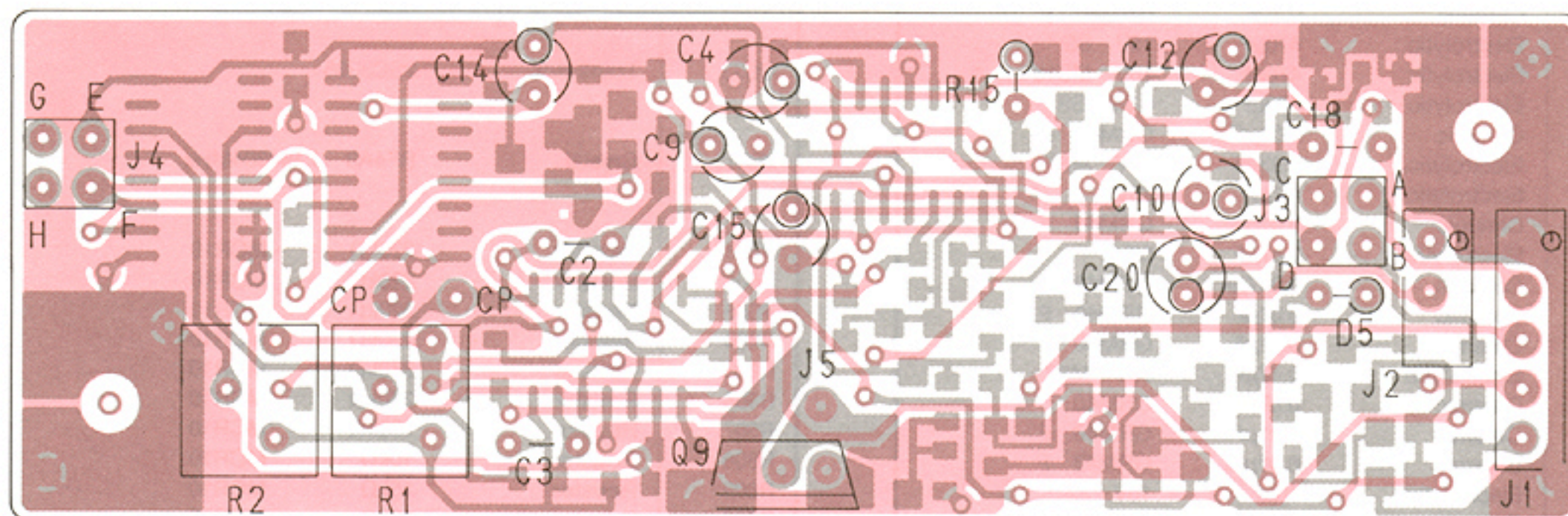
REF. NO.	DESCRIPTION	PART NO.
IC601	IC	NJM4558M
IC602	IC	MN6520
Q603	Transistor	2SC3395
X601	Crystal	RF4A3 4.194304MHz
R601	Resistor	220kΩ MCR10
R602	Resistor	220kΩ MCR10
R603	Resistor	220kΩ MCR10
R604	Resistor	220kΩ MCR10
R605	Resistor	270kΩ MCR10
R606	Resistor	220kΩ MCR10
R607	Resistor	180kΩ MCR10
R608	Resistor	10kΩ MCR10
R609	Resistor	15kΩ MCR10
R611	Resistor	10kΩ MCR10
R612	Resistor	2.2kΩ MCR10
R613	Resistor	10kΩ MCR10
R614	Resistor	150kΩ MCR10
R615	Resistor	1kΩ MCR10
C601	Ceramic	0.01μF GRM40 F
C602	Ceramic	0.022μF GRM40 B
C603	Ceramic	470pF GRM40
C604	Ceramic	0.033μF GRM40 F
C605	Ceramic	270pF GRM40
C606	Tantalum	SVA1D474M1
C607	Tantalum	SVD0J476M
C608	Ceramic	0.1μF GRM40 F
C609	Ceramic	18pF GRM40
C610	Ceramic	18pF GRM40
C611	Tantalum	SVA1D474M1
C612	Ceramic	0.1μF GRM40 F
C613	Tantalum	SVA1D474M1
J603	Connector	5513-14CPB
EP601	P.C. Board	B-1244A



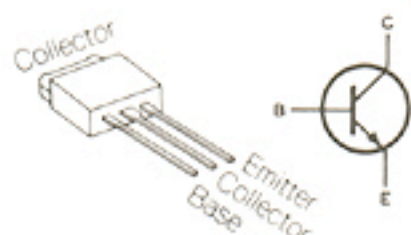
## OPTIONAL UNITS

## 9-1 UT-32 BOARD LAYOUTS

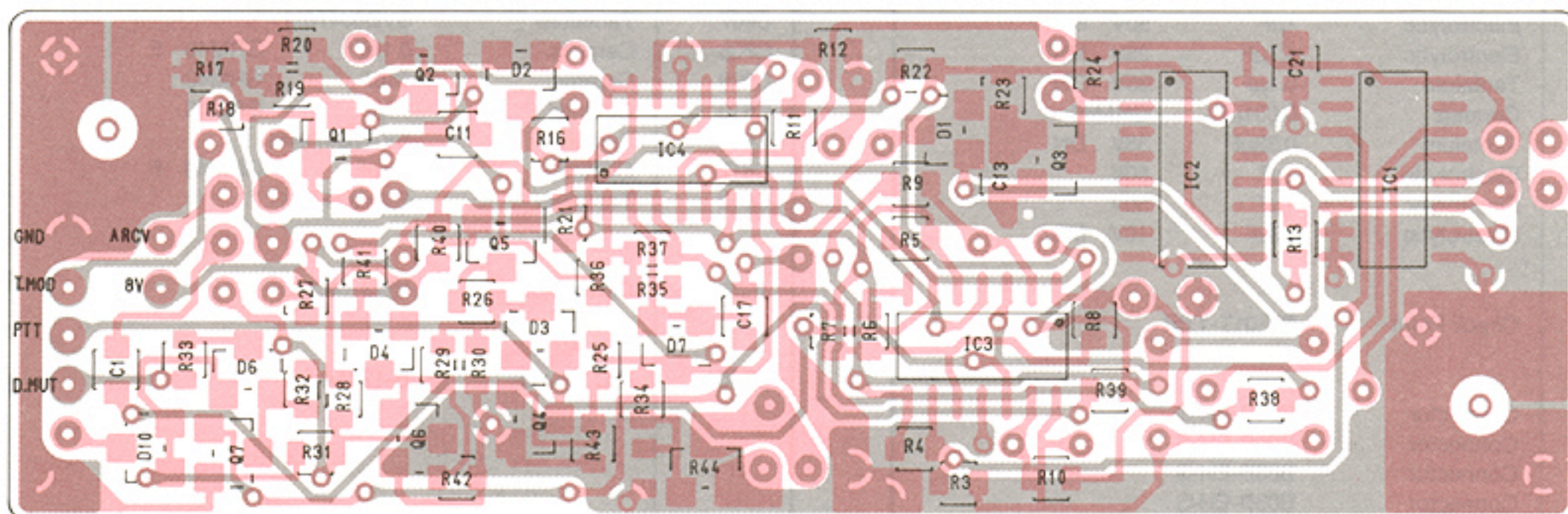
(Top View)



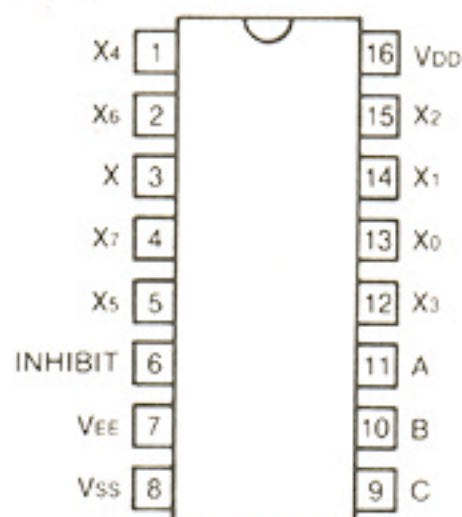
Q9  
2SD1286-L



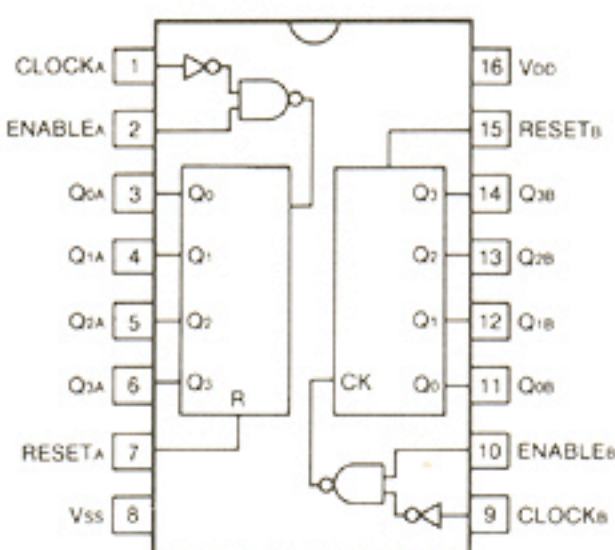
(Bottom View)



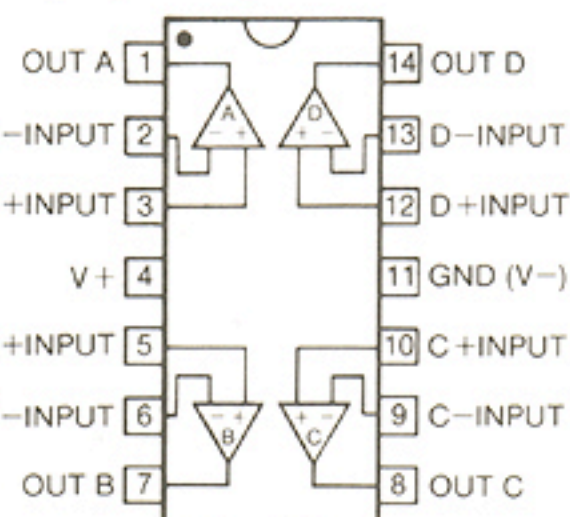
IC1  
μPD4051BG  
(SINGLE 8-CHANNEL  
MULTIPLEXER)  
(Top View)



IC2  
μPD4518BG  
(DUAL BCD UP  
COUNTER)  
(Top View)



IC3, IC4  
μPC324G  
(QUAD OPERATIONAL  
AMPLIFIER)  
(Top View)



Q1, Q2, Q5  
2SA1162-Y

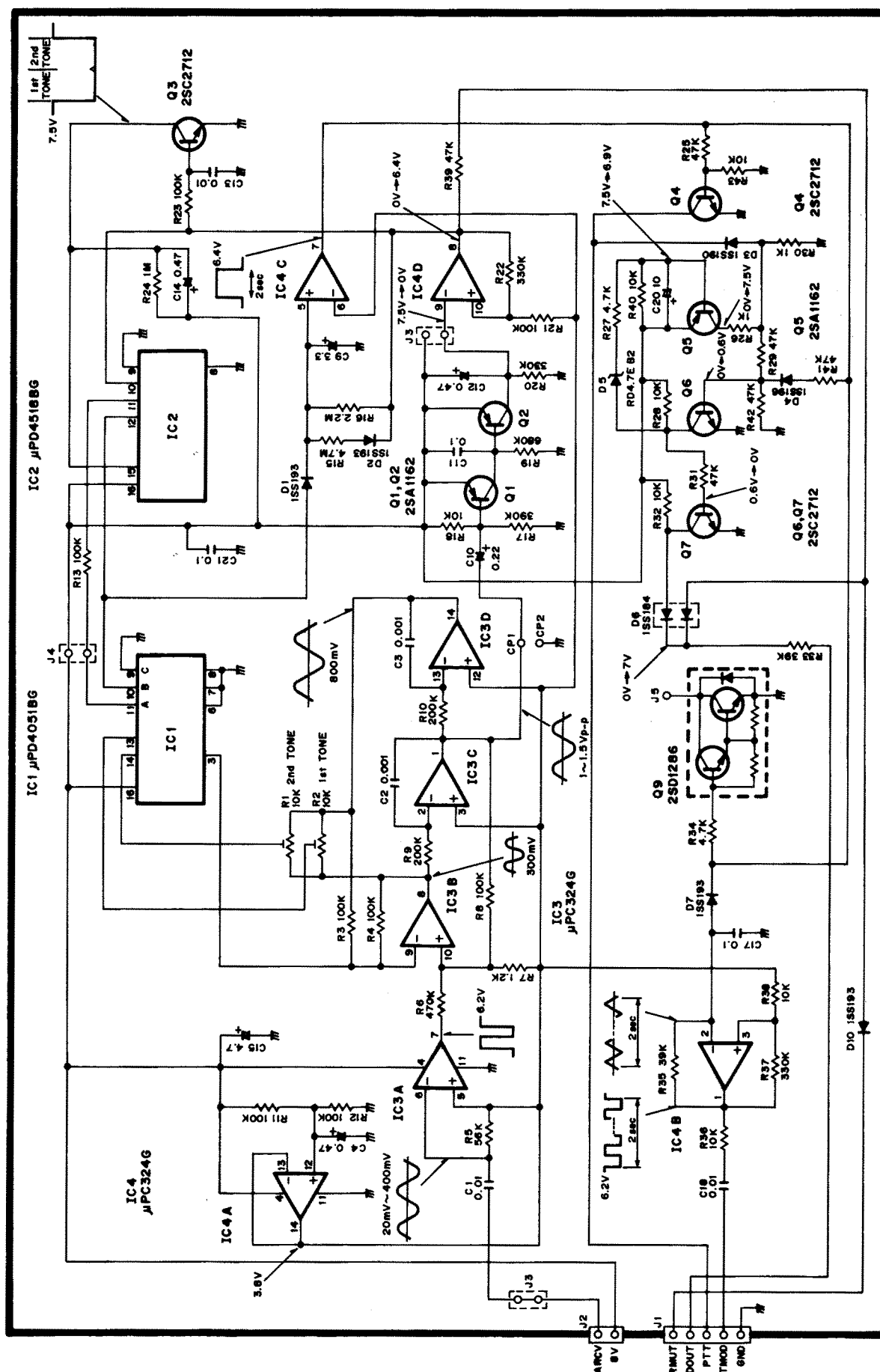


Q3, Q4, Q6, Q7  
2SC2712-Y





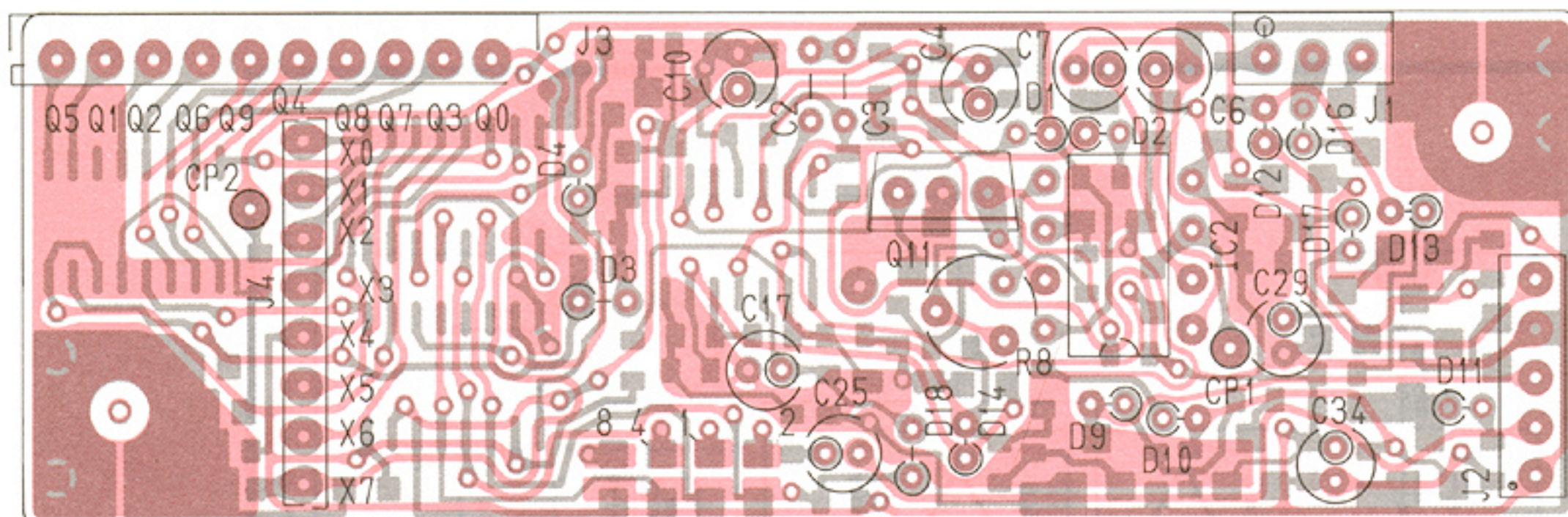
# 9-2 UT-32 VOLTAGE/CIRCUIT DIAGRAM



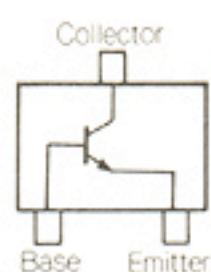


## 9-3 UT-33 BOARD LAYOUTS

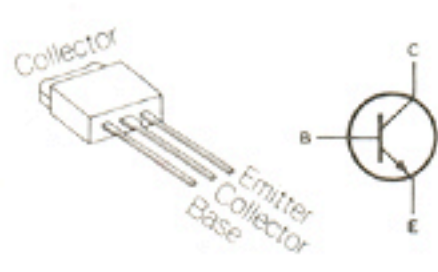
(Top View)



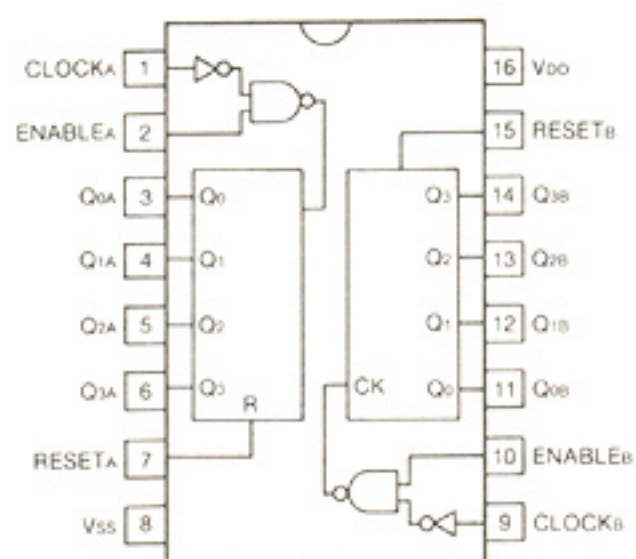
Q4  
2SC2712-Y



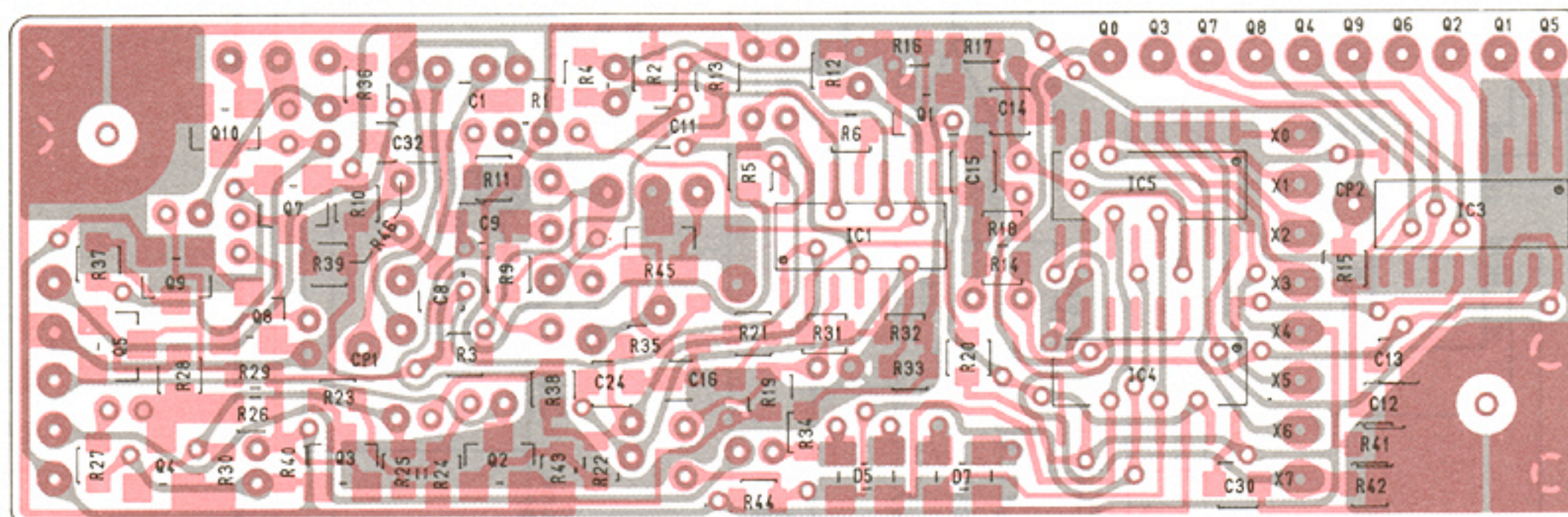
Q11  
2SD1286-L



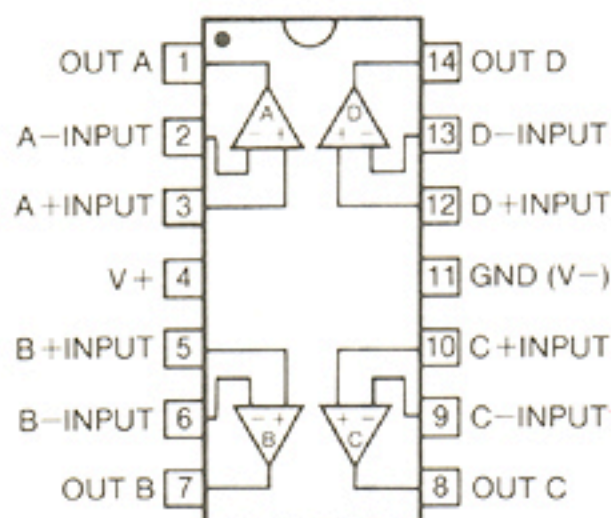
IC4  
 $\mu$ PD4518BG  
(DUAL BCD  
UP COUNTER)  
(Top View)



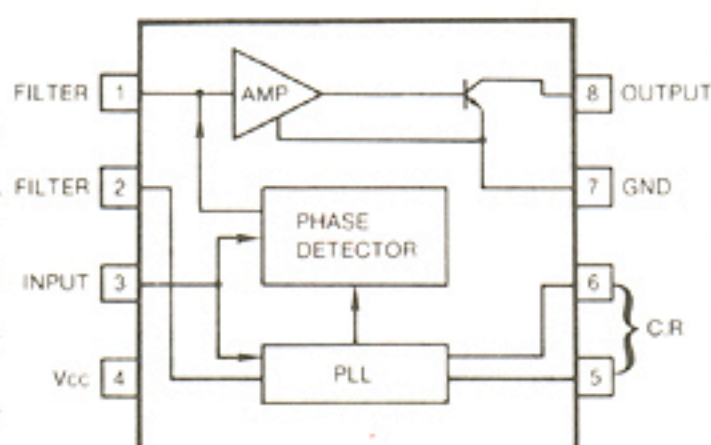
(Bottom View)



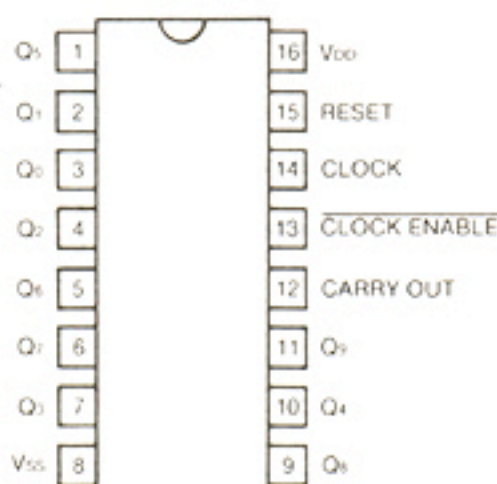
IC1  
 $\mu$ PC324G  
(QUAD OPERATIONAL  
AMPLIFIER)  
(Top View)



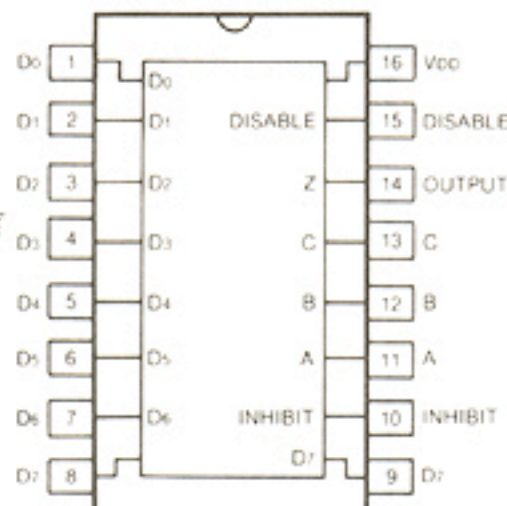
IC2  
BA1604  
(TONE ENCODER)  
(Top View)



IC3  
 $\mu$ PD4017BG  
(DECADE COUNTER/  
DIVIDER)  
(Top View)



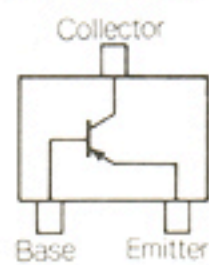
IC5  
 $\mu$ PD4512BC  
(8-CHANNEL DATA  
SELECTOR)  
(Top View)



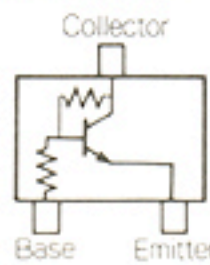
Q1, Q2, Q4, Q5  
2SC2712-Y



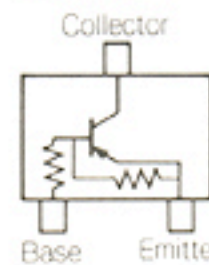
Q3  
2SA1162-Y



Q7, Q8, Q10  
2SC3395

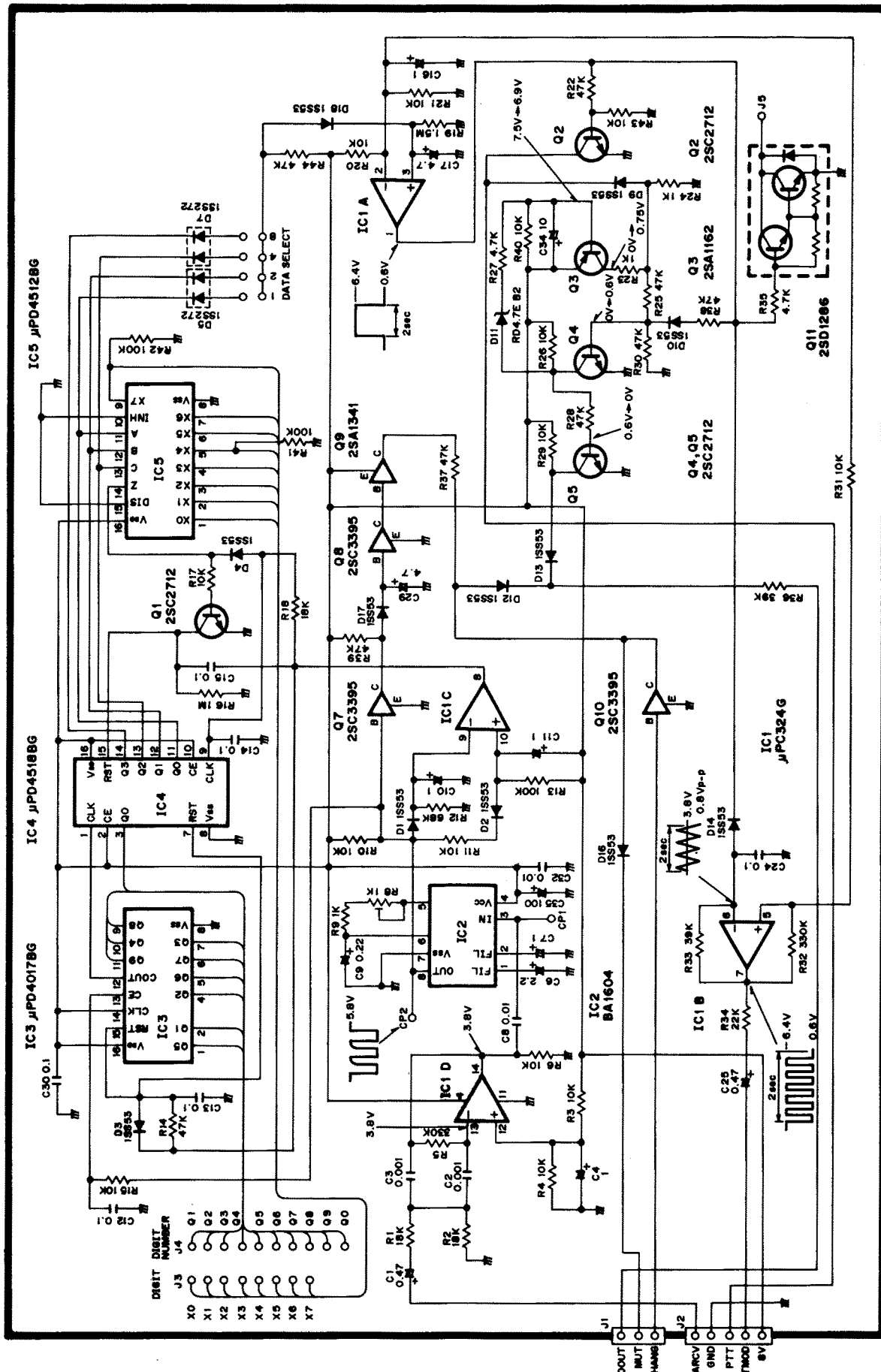


Q9  
2SA1341





# 9-4 UT-33 VOLTAGE/CIRCUIT DIAGRAM





## 9-5 UT-32 PARTS LIST

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	$\mu$ PD4051BG
IC2	IC	$\mu$ PD4518BG
IC3	IC	$\mu$ PC324G
IC4	IC	$\mu$ PC324G
Q1	Transistor	2SA1162-Y
Q2	Transistor	2SA1162-Y
Q3	Transistor	2SC2712-Y
Q4	Transistor	2SC2712-Y
Q5	Transistor	2SA1162-Y
Q6	Transistor	2SC2712-Y
Q7	Transistor	2SC2712-Y
Q9	Transistor	2SD1286-L
D1	Diode	1SS193
D2	Diode	1SS193
D3	Diode	1SS190
D4	Diode	1SS196
D5	Zener	RD4.7E B2
D6	Diode	1SS184
D7	Diode	1SS193
D10	Diode	1SS193
R1	Trimmer	RG06P 103 10k $\Omega$
R2	Trimmer	RG06P 103 10k $\Omega$
R3	Chip	100k $\Omega$ MCR10
R4	Chip	100k $\Omega$ MCR10
R5	Chip	56k $\Omega$ MCR10
R6	Chip	470k $\Omega$ MCR10
R7	Chip	1.2k $\Omega$ MCR10
R8	Chip	100k $\Omega$ MCR10
R9	Chip	200k $\Omega$ MCR10
R10	Chip	200k $\Omega$ MCR10
R11	Chip	100k $\Omega$ MCR10
R12	Chip	100k $\Omega$ MCR10
R13	Chip	100k $\Omega$ MCR10
R15	Resistor	4.7M $\Omega$ ERC14GJ
R16	Chip	2.2M $\Omega$ MCR10
R17	Chip	390k $\Omega$ MCR10
R18	Chip	10k $\Omega$ MCR10
R19	Chip	680k $\Omega$ MCR10
R20	Chip	330k $\Omega$ MCR10
R21	Chip	100k $\Omega$ MCR10
R22	Chip	330k $\Omega$ MCR10
R23	Chip	100k $\Omega$ MCR10
R24	Chip	1M $\Omega$ MCR10
R25	Chip	47k $\Omega$ MCR10
R26	Chip	1k $\Omega$ MCR10
R27	Chip	4.7k $\Omega$ MCR10
R28	Chip	10k $\Omega$ MCR10
R29	Chip	47k $\Omega$ MCR10
R30	Chip	1k $\Omega$ MCR10
R31	Chip	47k $\Omega$ MCR10
R32	Chip	10k $\Omega$ MCR10
R33	Chip	39k $\Omega$ MCR10
R34	Chip	4.7k $\Omega$ MCR10
R35	Chip	39k $\Omega$ MCR10
R36	Chip	10k $\Omega$ MCR10
R37	Chip	330k $\Omega$ MCR10
R38	Chip	10k $\Omega$ MCR10
R39	Chip	47k $\Omega$ MCR10
R40	Chip	10k $\Omega$ MCR10
R41	Chip	47k $\Omega$ MCR10
R42	Chip	47k $\Omega$ MCR10
R43	Chip	10k $\Omega$ MCR10
R44	Chip	0 $\Omega$ MCR10
C1	Monolithic	0.01 $\mu$ F GRM40
C2	Mylar	0.001 $\mu$ F 50V
C3	Mylar	0.001 $\mu$ F 50V
C4	Electrolytic	0.47 $\mu$ F 50V MS5

REF. NO.	DESCRIPTION	PART NO.
C9	Electrolytic	3.3 $\mu$ F 50V MS5
C10	Electrolytic	0.22 $\mu$ F 50V MS7
C11	Monolithic	0.1 $\mu$ F GRM40
C12	Electrolytic	0.47 $\mu$ F 50V MS7
C13	Monolithic	0.01 $\mu$ F GRM40
C14	Electrolytic	0.47 $\mu$ F 50V MS7
C15	Electrolytic	4.7 $\mu$ F 50V MS7
C17	Monolithic	0.1 $\mu$ F GRM40
C18	Mylar	0.01 $\mu$ F 50V
C20	Electrolytic	10 $\mu$ F 16V MS7
C21	Monolithic	0.1 $\mu$ F GRM40
CP1	Check Point	IPS-1136
CP2	Check Point	IPS-1136
J1	Connector	TLB-P05-A1
J2	Connector	TLB-P03-A1
J3	Connector	IMSA-9201B-2-04-T
J4	Connector	IMSA-9201B-2-04-T
J5	Connector	RT-01T-1.0B
P1	Connector	EHR-8
P3	Connector	IMSA-9201-HT
P4	Connector	IMSA-9201-HT
EP1	P.C. Board	B-1346B

## 9-6 UT-33 PARTS LIST

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	$\mu$ PC324G
IC2	IC	BA1604
IC3	IC	$\mu$ PD4017BG
IC4	IC	$\mu$ PD4518BG
IC5	IC	$\mu$ PD4512BG
Q1	Transistor	2SC2712-Y
Q2	Transistor	2SC2712-Y
Q3	Transistor	2SA1162-Y
Q4	Transistor	2SC2712-Y
Q5	Transistor	2SC2712-Y
Q7	Transistor	2SC3395
Q8	Transistor	2SC3395
Q9	Transistor	2SA1341
Q10	Transistor	2SC3395
Q11	Transistor	2SD1286-L
D1	Diode	1SS53
D2	Diode	1SS53
D3	Diode	1SS53
D4	Diode	1SS53
D5	Diode	1SS272
D7	Diode	1SS272
D9	Diode	1SS53
D10	Diode	1SS53
D11	Zener	RD4.7E B2
D12	Diode	1SS53
D13	Diode	1SS53
D14	Diode	1SS53
D16	Diode	1SS53
D17	Diode	1SS53
D18	Diode	1SS53

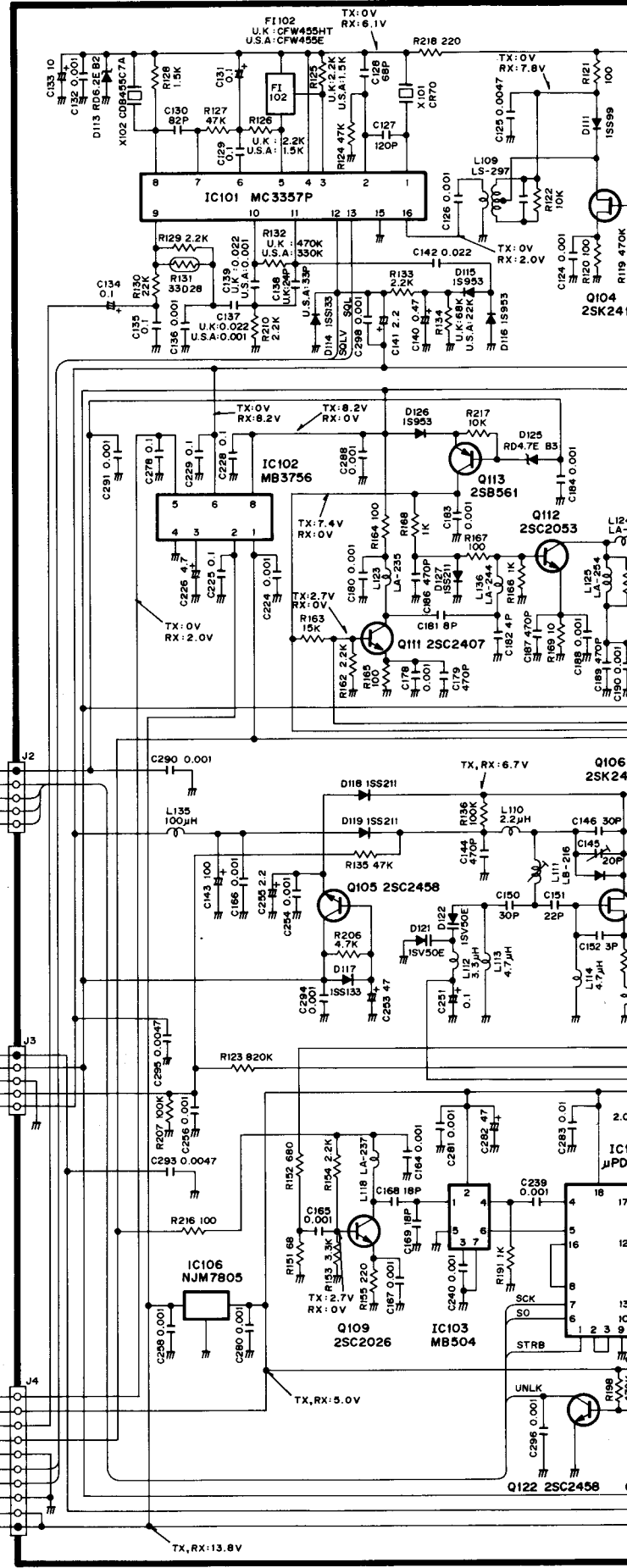
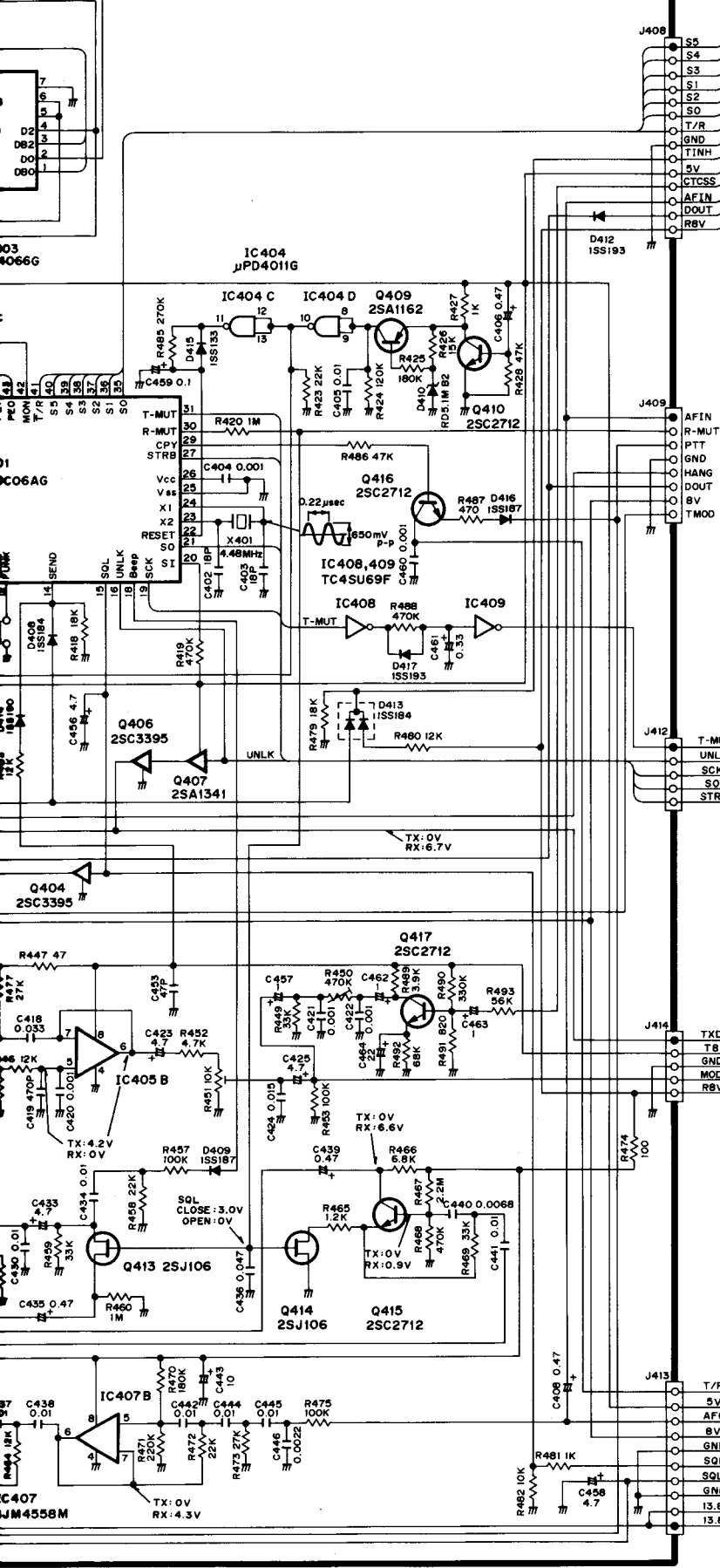
REF. NO.	DESCRIPTION	PART NO.	
R1	Chip	18k $\Omega$	MCR10
R2	Chip	18k $\Omega$	MCR10
R3	Chip	10k $\Omega$	MCR10
R4	Chip	10k $\Omega$	MCR10
R5	Chip	330k $\Omega$	MCR10
R6	Chip	10k $\Omega$	MCR10
R8	Trimmer	RH0651C13J1YA	1k $\Omega$
R9	Chip	1k $\Omega$	MCR10
R10	Chip	10k $\Omega$	MCR10
R11	Chip	10k $\Omega$	MCR10
R12	Chip	68k $\Omega$	MCR10
R13	Chip	100k $\Omega$	MCR10
R14	Chip	47k $\Omega$	MCR10
R15	Chip	10k $\Omega$	MCR10
R16	Chip	1M $\Omega$	MCR10
R17	Chip	10k $\Omega$	MCR10
R18	Chip	18k $\Omega$	MCR10
R19	Chip	1.5M $\Omega$	MCR10
R20	Chip	10k $\Omega$	MCR10
R21	Chip	10k $\Omega$	MCR10
R22	Chip	47k $\Omega$	MCR10
R23	Chip	1k $\Omega$	MCR10
R24	Chip	1k $\Omega$	MCR10
R25	Chip	47k $\Omega$	MCR10
R26	Chip	10k $\Omega$	MCR10
R27	Chip	4.7k $\Omega$	MCR10
R28	Chip	47k $\Omega$	MCR10
R29	Chip	10k $\Omega$	MCR10
R30	Chip	47k $\Omega$	MCR10
R31	Chip	10k $\Omega$	MCR10
R32	Chip	330k $\Omega$	MCR10
R33	Chip	39k $\Omega$	MCR10
R34	Chip	22k $\Omega$	MCR10
R35	Chip	4.7k $\Omega$	MCR10
R36	Chip	39k $\Omega$	MCR10
R37	Chip	47k $\Omega$	MCR10
R38	Chip	47k $\Omega$	MCR10
R39	Chip	47k $\Omega$	MCR10
R40	Chip	10k $\Omega$	MCR10
R41	Chip	100k $\Omega$	MCR10
R42	Chip	100k $\Omega$	MCR10
R43	Chip	10k $\Omega$	MCR10
R44	Chip	47k $\Omega$	MCR10
R45	Chip	0 $\Omega$	MCR10
R46	Resistor	47 $\Omega$	R10
C1	Electrolytic	SVA1E474M	
C2	Mylar	0.001 $\mu$ F	
C3	Mylar	0.001 $\mu$ F	
C4	Electrolytic	1 $\mu$ F	50V MS5
C6	Tantalum	2.2 $\mu$ F	16V
C7	Tantalum	1 $\mu$ F	35V
C8	Monolithic	0.01 $\mu$ F	GRM40 B
C9	Electrolytic	0.22 $\mu$ F	SVA1V224M1
C10	Electrolytic	1 $\mu$ F	50V MS5
C11	Electrolytic	SVA1C105M1	
C12	Monolithic	0.1 $\mu$ F	GRM40
C13	Monolithic	0.1 $\mu$ F	GRM40
C14	Monolithic	0.1 $\mu$ F	GRM40
C15	Monolithic	0.1 $\mu$ F	GRM40
C16	Electrolytic	SVA1C105M1	
C17	Electrolytic	4.7 $\mu$ F	25V MS5
C24	Monolithic	0.1 $\mu$ F	GRM40
C25	Electrolytic	0.47 $\mu$ F	50V MS5
C29	Electrolytic	4.7 $\mu$ F	25V MS5
C30	Monolithic	0.1 $\mu$ F	GRM40
C32	Electrolytic	SVA1V	103M1
C34	Electrolytic	10 $\mu$ F	16V MS5
C35	Electrolytic	100 $\mu$ F	10V MS7
CP1	Check Point	IPS-1136	
CP2	Check Point	IPS-1136	

REF. NO.	DESCRIPTION	PART NO.
J1	Connector	TLB-P03-A1
J2	Connector	TLB-P05-A1
J3	Connector	10B-SQ
J4	Connector	08B-SQ
J5	Connector	RT-01T-1.0B
P1	Connector	EHR-8
EP1	P.C. Board	B-1347A

## CTCSS UNIT



# LOGIC UNIT



# MAIN UNIT

The diagram illustrates the internal circuitry of the MAIN UNIT, featuring a variety of electronic components and their interconnections. Key components include:

- Transistors:** Q101 (2SK241), Q102 (2SC3355), Q103 (2SC3355), Q104 (2SK241), Q106 (2SK241), Q107 (2SC2026), Q108 (2SC2026), Q109 (2SC2026), Q110 (2SC2026), Q111 (2SC2026), Q112 (2SC2053), Q113 (2SB561), Q114 (2SB596), Q115 (2SC945), Q116 (2SC945), Q117 (2SC2458), Q118 (2SA1048), Q119 (2SC2458), Q120 (2SK184), Q121 (2SC2458), Q122 (2SC2458).
- Diodes:** D101-D110 (1SV153), D121 (RD4.7E B3), D122 (1SV50E), D123 (1SV50E), D124 (1SV50E), D125 (1SV50E), D126 (1SV50E), D127 (1SV50E), D128 (1SV50E), D129 (1SV50E), D130 (1SV50E), D131 (1SV50E), D132 (1SV50E), D133 (1SV50E), D134 (1SV50E), D135 (1SV50E), D136 (1SV50E), D137 (1SV50E), D138 (1SV50E), D139 (1SV50E), D140 (1SV50E), D141 (1SV50E), D142 (1SV50E), D143 (1SV50E), D144 (1SV50E), D145 (1SV50E), D146 (1SV50E), D147 (1SV50E), D148 (1SV50E), D149 (1SV50E), D150 (1SV50E), D151 (1SV50E), D152 (1SV50E), D153 (1SV50E), D154 (1SV50E), D155 (1SV50E), D156 (1SV50E), D157 (1SV50E), D158 (1SV50E), D159 (1SV50E), D160 (1SV50E), D161 (1SV50E), D162 (1SV50E), D163 (1SV50E), D164 (1SV50E), D165 (1SV50E), D166 (1SV50E), D167 (1SV50E), D168 (1SV50E), D169 (1SV50E), D170 (1SV50E), D171 (1SV50E), D172 (1SV50E), D173 (1SV50E), D174 (1SV50E), D175 (1SV50E), D176 (1SV50E), D177 (1SV50E), D178 (1SV50E), D179 (1SV50E), D180 (1SV50E), D181 (1SV50E), D182 (1SV50E), D183 (1SV50E), D184 (1SV50E), D185 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(1SV50E), D452 (1SV50E), D453 (1





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